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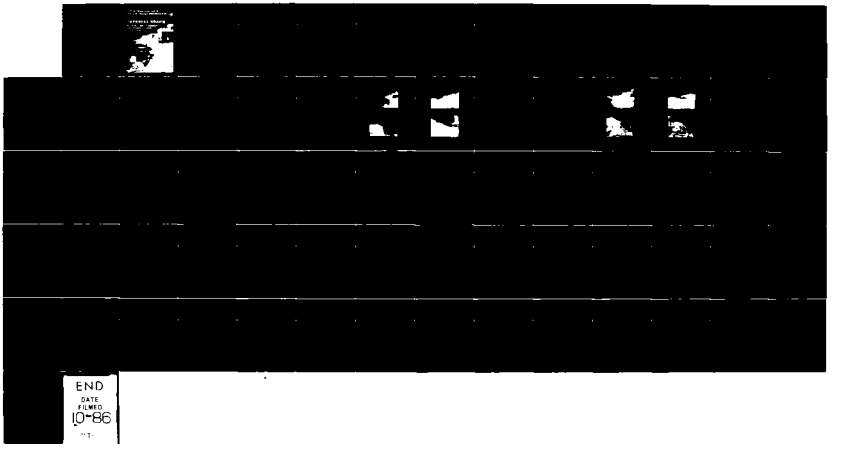

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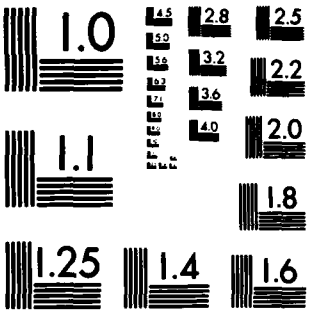

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This report presents the beach erosion problem along the Imperial Beach shoreline. Two general memorandums are prepared for the projects by the Corps of Engineers to be reactivated as requested by the City of Imperial Beach for building the city's beachfront to restore and stabilize the recreational beach area.

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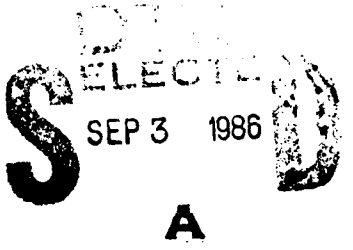

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Daniel Muslin
Project Manager

CONTENTS

CONTENTS (Continued)

CONTENTS (Continued)

Tables

CONTENTS (Continued)

SYLLABUS

The beach erosion control project at Imperial Beach was authorized by the River and Harbor Act of 1958.

The authorized project provides for a system of five stone groins, the most northern groin about 600 feet long at the north end of the existing seawall at the naval radio station, and each of the other groins about 400 feet long and spaced at intervals of about 1,000 feet southward to a point 400 feet south of Coronado Avenue. The Corps of Engineers in 1959 constructed groin No. 1 upcoast from Carnation Avenue to a length of 600 feet; and in 1961 groin No. 2 at Palm Avenue to a length of 400 feet. In 1963, groin No. 1 was extended 140 feet to a length of 740 feet. These two groins did not function as expected, thus necessitating further investigations to develop an alternative plan for beach protection.

The recommended project comprises: construction of a 5,000-foot-long breakwater at the minus 10-foot contour, extension of groin No. 1, and construction of a south groin. The benefits that would accrue to the Federal Government and the public from maintaining the recreational beach and protecting private and public properties justify the costs to the United States and to local interests.

The cost to the United States for the project is estimated at $1,470,000 and the local interests' share is estimated to be $1,090,000. The benefit-cost ratio of the project is estimated at 4.5 to 1.0, based on March 1978 prices, an amortization period of 50 years, and an amortization rate of 2-5/8 percent. The benefit-cost ratio based on an amortization rate of 6-5/8 percent is 1.3. to 1.0.

PERTINENT DATA

GENERAL		
Datum plane is mean lower low water (MLLW)	feet	0.0
Mean sea level (MSL)	feet	plus 2.9
Range of tide		
Mean	feet	3.7
Diurnal	feet	5.3
Extreme	feet	10.0
PROJECT DETAILS		
Beach		
Federal	feet	700
Non-Federal	feet	4,300
Width	feet	125
Proposed structures		
Breakwater	feet	5,000
Groin No. 1 extension	feet	100
South groin	feet	600
Navigational aids	each	3
Construction material quantities		
7-Ton conglomerate	ton	76,870
5-Ton conglomerate	ton	25,610
1,000-Pound stone	ton	11,170
Plastic filter cloth	sq ft	334,400
ESTIMATED COSTS AND BENEFIT-COST RATIO		
Federal total cost of improvements		$1,470,000
Non-Federal total cost of improvements		$1,090,000
Benefit-cost ratio (2-5/8%, 50-year life)		4.5 to 1.0

PRIOR REPORTS

No.	Submittal Date	Title	Approval Date
1	May 1959	Construction of Groin No. 1, Imperial Beach, California	June 1959
2	Sept 1960	Design Memorandum, General Design for Shore Protection Works at Imperial Beach, California (Groin No. 2)	Oct 1960
3	Sept 1962	Construction of Groin No. 3 at Imperial Beach, California	Suspended

INTRODUCTION

General

There is a beach erosion problem along the Imperial Beach shoreline. This problem became acute during the winter of 1952-53 when waves caused damage to private and public property. The City of Imperial Beach desires to prevent further erosion and to restore and maintain the former width of the recreational beach.

The Corps of Engineers was authorized in 1958 to build five stone groins along the city's beachfront to restore and stabilize the recreational beach. Two of the groins were built between 1959 and 1963, but were not effective. Further implementation of this project, therefore, was deferred.

The City of Imperial Beach then requested that the Corps of Engineers reactivate this project and investigate alternative means to restore and provide effective beach stabilization.

Without effective beach erosion control improvements, the City of Imperial Beach will continue to lose a valuable beach resource and will sustain damages to private and public property from erosion and flooding. This report was prepared in response to this need.

Scope of report

Two general design memorandums (GDM's) are usually prepared for a project: a Phase I - Plan Formulation, and a Phase II - Project Plan. For this project, approval was granted to combine the two reports into a single GDM because: (a) with a minimum expansion of the requirements for the Phase I GDM, the requirements of the Phase II GDM could also be met; and (b) there would be a time savings of over a year by preparing only one report.

The scope of this report is that as outlined in ER 1110-2-1150 and draft ER 1105-2-30. The report complies with the requirements of section 122 of Public Law 91-611, but does not strictly comply with the requirements of the Principles and Standards because this project was authorized before 1969. A 2-5/8-percent interest rate is used in reformulating this project because local cooperation assurances were furnished before 31 December 1969. A sensitivity analysis at 6-5/8 percent is included.

The authorized project has been reformulated to develop a viable solution to the continuing erosion problem.

A final environmental impact statement (FEIS) is included in compliance with the National Environmental Policy Act of 1969.

Project authorization

AUTHORITY

The Imperial Beach, San Diego County, California, project was authorized by the River and Harbor Act of 1958 (Public Law 85-500), which states, in part, as follows:

> SEC. 101. That the following works of improvement of rivers and harbors and other waterways for navigation, flood control, and other purposes are hereby adopted and authorized to be prosecuted under the direction of the Secretary of the Army and supervision of the Chief of Engineers, in accordance with the plans and subject to the conditions recommended by the Chief of Engineers in the respective reports hereinafter designated: Provided, that the provisions of section 1 of the River and Harbor Act approved March 2, 1945 (Public Law Numbered 14, Seventy-ninth Congress, first session), shall govern with respect to projects authorized in this title; and the procedures therein set forth with respect to plans, proposals, or reports for works of improvement for navigation or flood control and for irrigation and purposes incidental thereto, shall apply as if herein set forth in full:
>
> * * * * * * *
>
> * * * San Diego County, California: House Document Numbered 399, Eighty-fourth Congress, at an estimated cost of $289,000;* * *

LOCAL COOPERATION

House Document No. 399, hereinafter referred to as the project document, specifies the following requirements of local cooperation:

a. Obtain approval by the Chief of Engineers, prior to commencement of work on project, of detailed plans and specifications and arrangements for prosecution of the work on that project;

b. Provide at their own expense all necessary lands, easements, and rights-of-way;

c. Control water pollution to the extent necessary to safeguard the health of bathers, except that which involves international cooperation;

d. Assure maintenance of the protective measures during the useful life of the project, as may be required to serve its intended purpose; and

e. Assure continued public ownership of the beach and its administration for public use during the useful life of the project.

Purpose of study

The initial purpose of the present study, Design Memorandum No. 4, was to investigate the efficiency and adequacy of the existing authorized Federal project as a means for shore protection for the Imperial Beach shoreline. As the study progressed and public participation in relation to the study evolved, it became evident that there was a need to reformulate and develop a plan more suitable for the solution to the beach erosion problem.

AUTHORIZED PLAN

General

The plan set forth in the project document provides for a system of five stone groins, the most northern groin about 600 feet long at the north end of the existing seawall at the U.S. Naval Radio Station, and each of the other groins about 400 feet long and spaced at intervals of about 1,000 feet southward to a point about 400 feet south of Coronado Avenue. (See fig. 1.) Construction would start with the most northern groin and would proceed with the others successively southward only when the downcoast side of each groin has filled. Based upon the littoral drift and wave studies, sufficient material would be impounded on the southern or updrift sides of the groins to widen the beach a minimum of 100 feet and to provide an adequate protective beach fronting the area subject to damage by erosion and flooding.

Status

The Corps of Engineers in 1959 constructed groin No. 1 upcoast from Carnation Avenue to a length of 600 feet; and in 1961 constructed groin No. 2 at Palm Avenue to a length of 400 feet. In 1963, groin No. 1 was extended 140 feet to a length of 740 feet. To date, however, the compartment between groins No. 1 and No. 2 has not filled. Therefore, the ineffectiveness of these two groins has caused the construction of groins Nos. 3, 4, and 5 to be deferred. This report discusses alternative plans that have been investigated.

DESCRIPTION OF AREA

Location and extent

The City of Imperial Beach, incorporated in 1956, is on the coast of southern California in San Diego County. The city is bounded on the north by the City of Coronado, on the east by the City of San Diego, and on the south by the international boundary with Mexico. Imperial Beach is fronted by a sandy recreational beach about 7,000 feet long. At present, the northern 4,300 feet is approximately 125 feet wide and the southern 2,700 feet is less than 10 feet wide. This beach area is included in a 14-mile segment of shoreline that is alined in a north-south direction. (See fig. 2.)

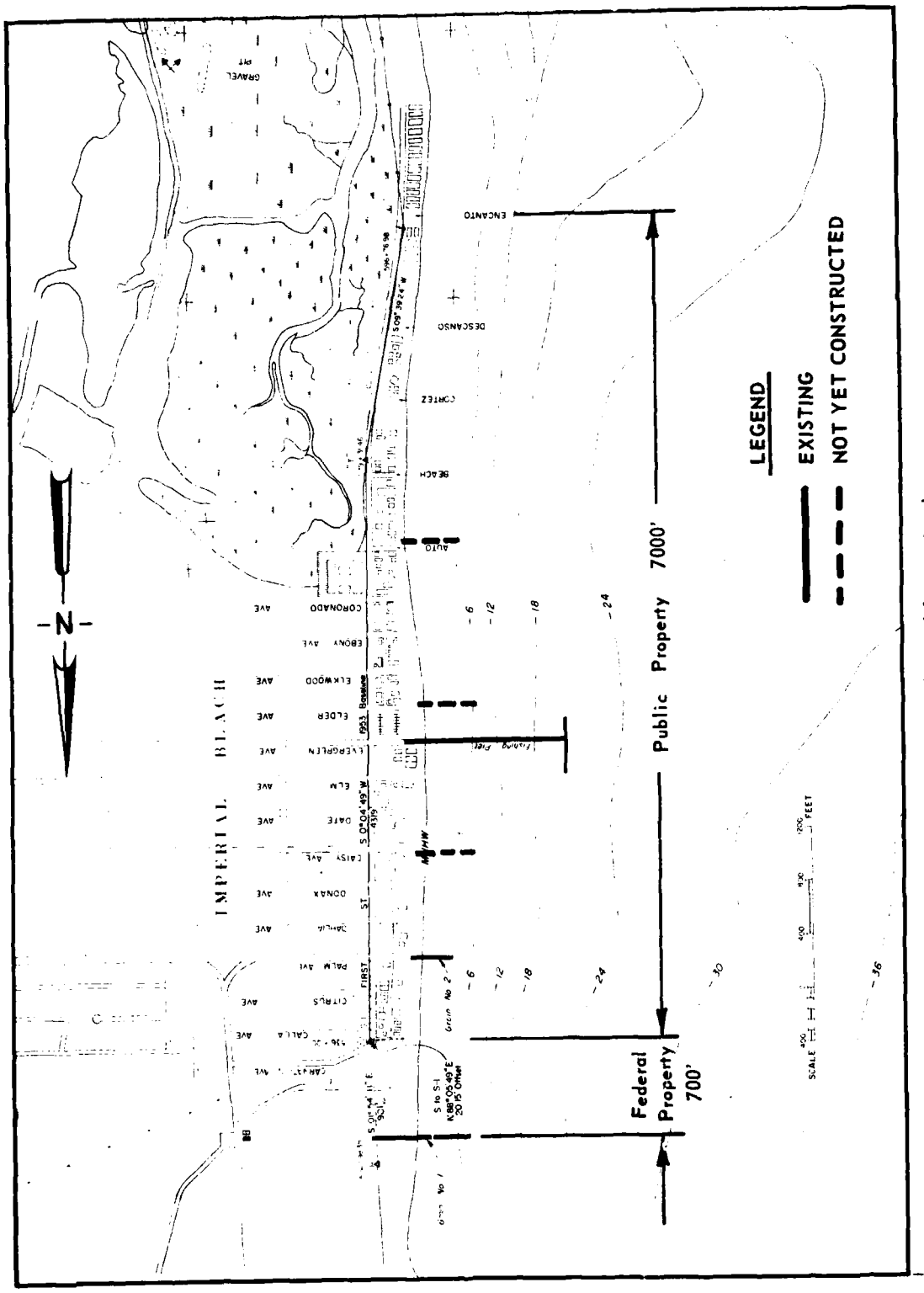


Figure 1. Authorized five-groin plan.

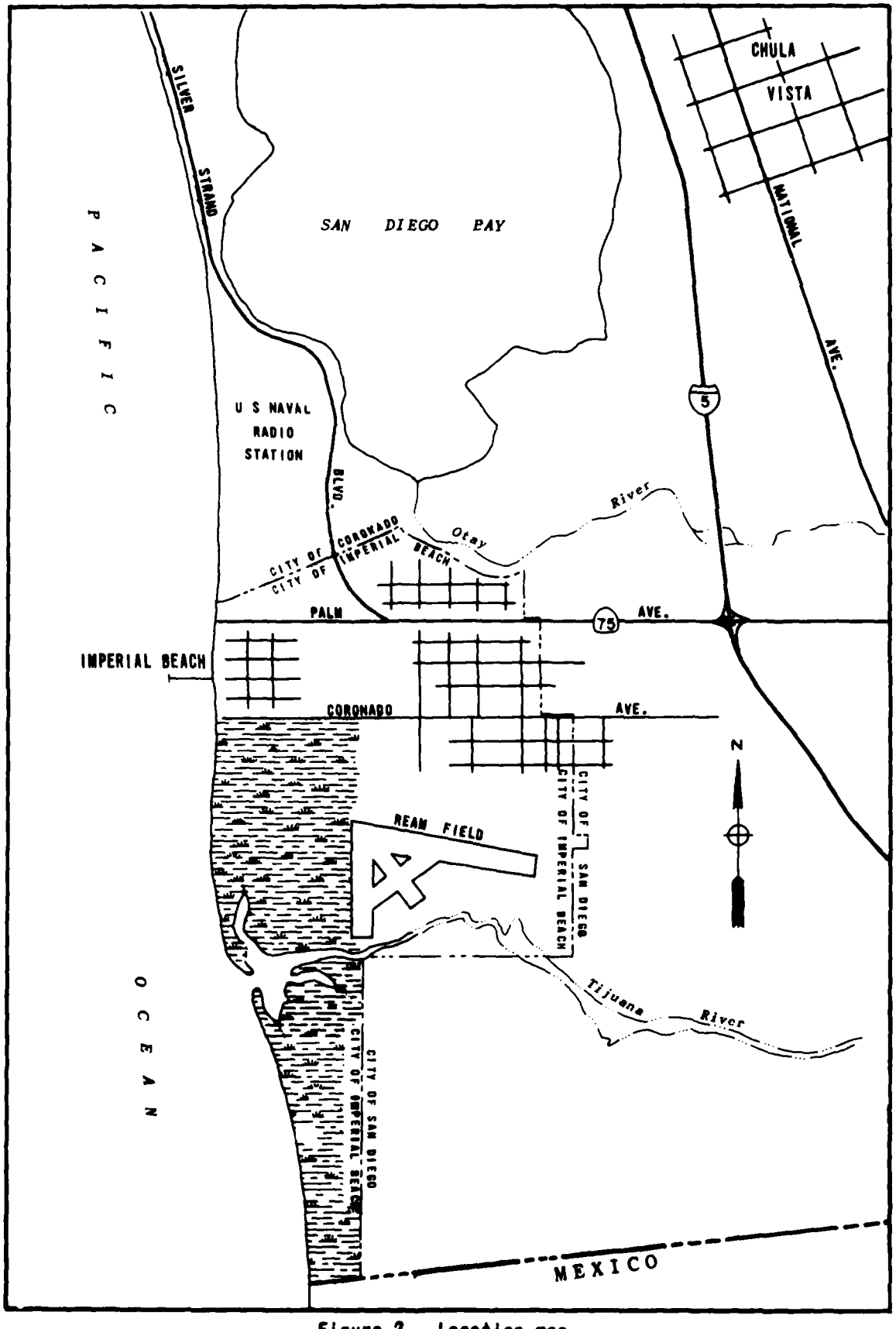


Figure 2. Location map.

Tributary areas

The recreational demand tributary area includes the area within a 15-mile distance and a 20-minute travel time from Imperial Beach. The tributary area encompasses the Cities of National City, Chula Vista, and Imperial Beach; the communities of Palm City, Otay Mesa, Nestor, and San Ysidro in the City of San Diego; and the Sweetwater area of the unincorporated portion of San Diego County. Appendix D discusses the existing socioeconomic aspects within this tributary area in detail.

Environmental setting

Imperial Beach and surrounding areas lie on a broad flat plain with little topographic relief. The U.S. Naval Radio Station and San Diego Bay lie to the north of the project area, while the Tijuana River estuary and Ream Field lie to the south. The beach in the project area consists of cobbles that are generally exposed during the winter months and covered by a veneer of sand during the summer.

The area has a subtropical, mediterranean climate typical of coastal southern California. The average annual rainfall for the San Diego area is about 10 inches, most of which occurs in winter months from November to March. Temperatures in the Imperial Beach - San Diego area are quite mild. The average daily maximum temperatures for the four seasons are: winter, 62 degrees; spring, 66 degrees; summer, 72 degrees; and fall, 67 degrees.

No significant natural terrestrial plant communities occur in the immediate project study area since practically all the backshore has been developed for residential and parking uses. Shoreline and intertidal sandy beach habitats are utilized by bird species for feeding and resting. The Tijuana estuary lies immediately outside and south of the proposed project area.

The marine environment in the project study area contains the following habitats: intertidal sandy beach; subtidal sandy bottom; artificial rocky shore; pier piling; subtidal cobblestone; and water column. The intertidal sandy beach habitat appears typical of that found at other southern California intertidal sandy beaches. Artificial rocky shore habitat occurs along the two existing rock groins located at the north end of the project site. Subtidal sandy bottom habitat is the most common habitat in the proposed project area. Nearshore subtidal cobblestone habitat occurs downcoast 2,500 feet from the project area to the mouth of the Tijuana River. An offshore subtidal cobblestone community exists south and seaward of the end of the Imperial Beach pier. The Imperial Beach pier pilings support a biotic community typical of piling communities in southern California. Biotic resources for the project area are discussed in greater detail in the chapter of the Final Environmental Statement, which accompanies this report, titled "Environmental Setting Without the Project."

The Fish and Wildlife Service's Detailed Fish and Wildlife Coordination Act Report (January 1978) identifies the California least tern, the light-footed clapper rail, and the brown pelican as residents of areas in proximity to the site. No endangered plant species were identified as occurring in the project area. The State Historic Preservation Officer and the National Park Service have determined that there are no known archeological resources in the project area.

Social characteristics

According to the State Department of Finance D-100 population projections as of 1 January 1977, expanded naval, commercial, and industrial employment opportunities in San Diego County have historically increased the population of the tributary area, which in 1973 was 198,700. All available population projections indicate that these trends will continue, with the total population of the tributary area increasing to 318,200 people by 1995, a 60-percent increase.

Imperial Beach is the southernmost improved beach within San Diego County. Recreational beaches south of the mouth of the Tijuana River lack sanitary and lifeguard facilities. Access to the beaches along the Silver Strand in the City of Coronado entails passing through Imperial Beach or crossing the Coronado Bay toll bridge. Both highway and bus services, however, provide direct regional access to Imperial Beach, making it the most accessible recreational family beach available to the inhabitants of this tributary area.

Imperial Beach demonstrates a highly mobile population. This high mobility is due to the large percentage of military personnel living within the city and to the substantial population of college students. These two factors also explain the low mean age of Imperial Beach's population—22.2 years of age—and the renter-occupied nature of the city's housing. In 1975, a census indicated that renter occupancy of the housing units was about 73 percent. Most of the alternatives studied in this report would increase property values within the project area as well as within the City of Imperial Beach. This increase in property values would be caused by the city becoming a more desirable place to live. Beachfront property would increase in value, not only because the property would be protected from erosion damage but also because most of the alternatives would provide a recreational beach. The increase in property values within Imperial Beach would probably be passed on to the renters. Therefore, implementation of a project might increase the portion of disposable income that would be expended on housing.

Apart from naval personnel, the largest number of people are either clerical workers or craftsmen. Compared to San Diego County as a whole, however, fewer are professionally employed. Consequently, the lack of professionals along with a higher percentage of nonskilled workers and military personnel results in a lower median income for Imperial Beach and its tributary area than that of San Diego County. For comparison, the estimated 1976 median family income for Imperial Beach is $14,364 and the estimated median income for the Imperial Beach tributary area is $16,453, whereas the estimated 1976 median income for San Diego County is $18,613.

Because of its proximity to the border and the large amount of transborder commerce that takes place, the tributary area exhibits a higher proportion of Spanish-American surnamed individuals than can be found in San Diego County or in the State of California.

In general, therefore, the characteristics of Imperial Beach and its tributary area are that of a young, highly mobile, low- to middle-income population. The beach that would be provided by the recommended plan would provide a major, if not exclusive, recreational resource to these individuals.

Imperial Beach is now used for surfing. However, the offshore breakwater and submerged offshore breakwater alternatives might reduce the surfing along the portion of the beach that is in the project area.

Recreational resources

Imperial Beach is located in the extreme southwest corner of the county, and has had a continual erosion problem due to lack of natural sand replenishment. Currently, Imperial Beach can be characterized as a fairly wide sandy beach due to the recent placement of dredged material on the beach from the San Diego Bay navigation dredging project. The area enjoys a warm sub-tropical climate with an average daily maximum temperature of 67 degrees and an average rainfall of 10 inches annually. Current uses of the beach are for general beach recreation and surfing. Projections indicate Imperial Beach is in an area which will experience strong sustained growth over the next 50 years. The recreational use demand for Imperial Beach is given in the following table:

Recreational Use Demand – Imperial Beach

Year	Number of Users Annually
1975	346,000
1980	388,000
1990	493,000
2000	592,000
2010	751,000
2020	950,000
2030	1,068,000

Currently at Imperial Beach there is a fishing pier at the foot of Evergreen Street and a lifeguard station at the end of Palm Avenue. There is a parking lot at the pier for 135 autos, and nearby streets can provide 986 additional parking spaces. With future use of Imperial Beach intensifying, additional parking will be necessary. Peak attendance at Imperial Beach can be expected to be about 6,700 users. Assuming 2.5 persons per auto and 80% of users using autos, an additional 1,020 parking spaces will be needed by 2030. Several additional lifeguard stations and restrooms will also be needed to accommodate the increased usage.

Ownership and development of the shore

The U.S. Navy owns the beach area north from Carnation Avenue to groin No. 1 (700 feet), and the City of Imperial Beach owns the beach area south from Carnation Avenue to the southern city limits. The area above the mean higher high water (MHHW) line is privately owned. Figure 1 shows the various ownerships and the length of each ownership within the project area.

Bordering the shoreline area at Imperial Beach on its landward side are homes, apartments, motels, and parking facilities. A rubblemound groin (No. 1) is 700 feet upcoast from Carnation Avenue and another one (No. 2) is at Palm Avenue. A lifeguard headquarters is at the foot of groin No. 2.

Photo 1. Looking north from Palm Avenue (March 1977).

Photo 2. Looking south from Palm Avenue (March 1977).

Photo 3. Looking north from Coronado Avenue (March 1977).

Photo 4. Looking south from Coronado Avenue (March 1977).

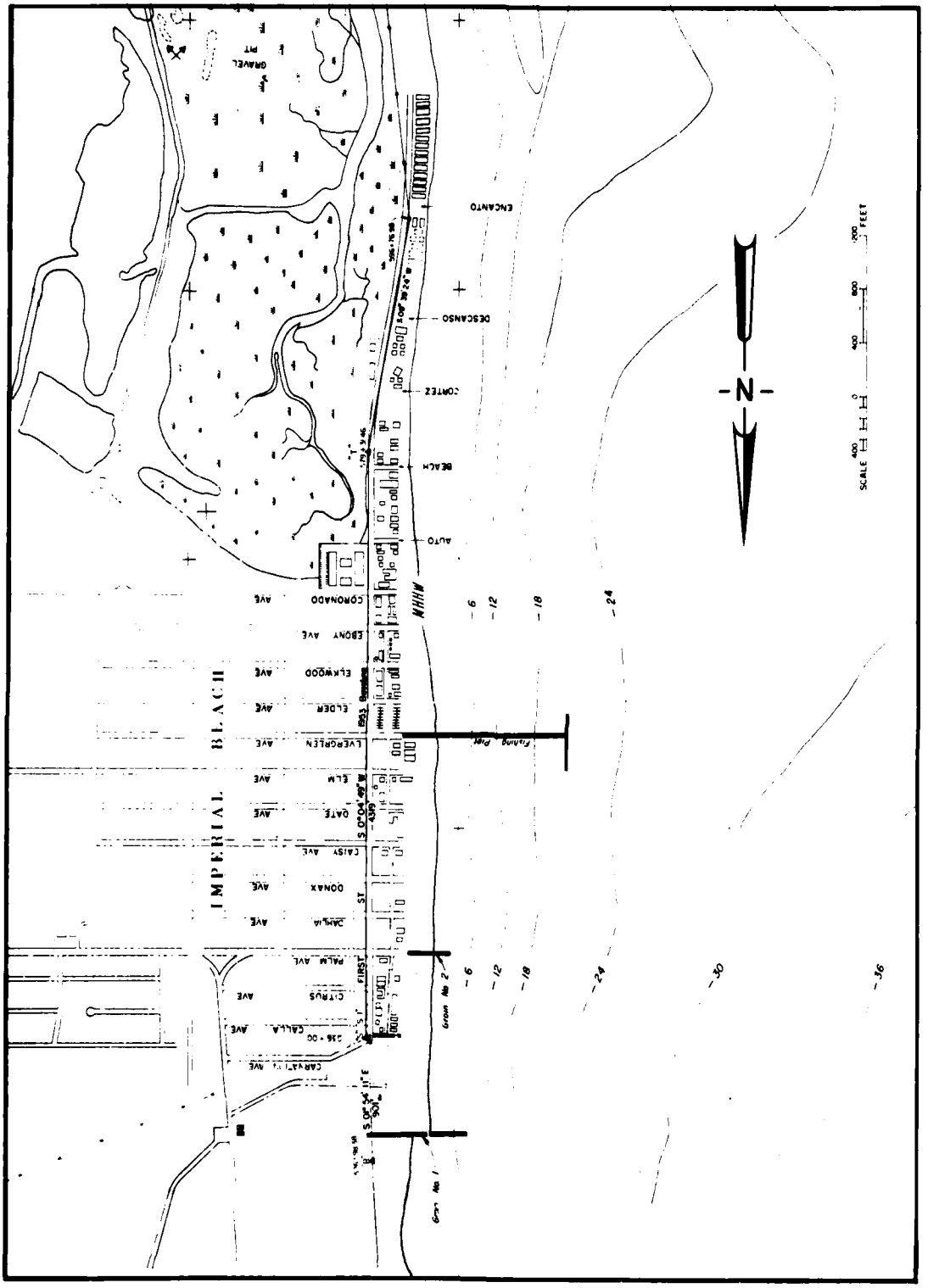


Figure 3. Anticipated beach width and development along the shoreline.

The large number of automobiles per capita plus the year-round use of beaches in southern California result in very high use of beach facilities.

PROBLEM AND NEEDS

The problem at Imperial Beach is one of gradual beach erosion caused by an inadequate natural supply of beach material. Control structures that have reduced floodflows in the lower Tijuana River, coupled with the relative lack of floods since 1928, have greatly reduced the volume of detritus brought to the shore. At the time of the project authorization, the beach width had been greatly reduced.

The lack of a protective beach has exposed public and private property to damage. (See photos 1 through 4.) The shoreline at Imperial Beach receded to such an extent during the winter of 1952-53 as to cause damage to public and private property estimated at between $15,000 and $25,000. Further damage from erosion is endangering property fronting the beach, and property in the low-lying areas inland is subject to flooding when the beach berm is overtopped.

The Federal Government has expended about $33,000 to protect the facilities at the naval radio station immediately north of Imperial Beach. These funds are a percentage of the authorized project cost based on the Federal versus public shoreline length. Local naval officials desire protection of their facilities, which are threatened with serious damage if the erosion is not checked.

The problem is now so severe that some homes in the southern part of the beach are in extreme danger during the winter. In this area, there is a minimal beach during the summer (50 feet) and almost no beach during the winter (10 feet or less). In the northern area, the average beach width is 125 feet. Local interests desire the prevention of further erosion of the shoreline and the restoration of the former width of the entire recreational beach. The erosion rate in the northern area is greater than in the southern area because of the greater availability of material to erode.

Figure 3 indicates the present beach width along the shoreline. With an estimated 4 feet of erosion per year on an average basis, $2,667,000 of public and private property will be subject to loss during the 50-year project life if the property is not protected by a project. (This figure was computed using current price levels and assuming no future development.)

As the beach erodes at 4 feet per year, 53,400 visitor days per year will be lost. (For derivation, see the section in Appendix D of this report titled "Capacity of beach without project." During the year 2009, the beach will be completely eroded and damage to residential property fronting the beach is expected to begin in the proposed project area.

FACTORS PERTINENT TO THE PROBLEM

Littoral materials

Littoral materials are those sediments naturally or artificially introduced that move under the influence of waves in the zone extending seaward from the shoreline to just beyond the breaker (surf) zone. Characteristics and sources of materials are important factors in

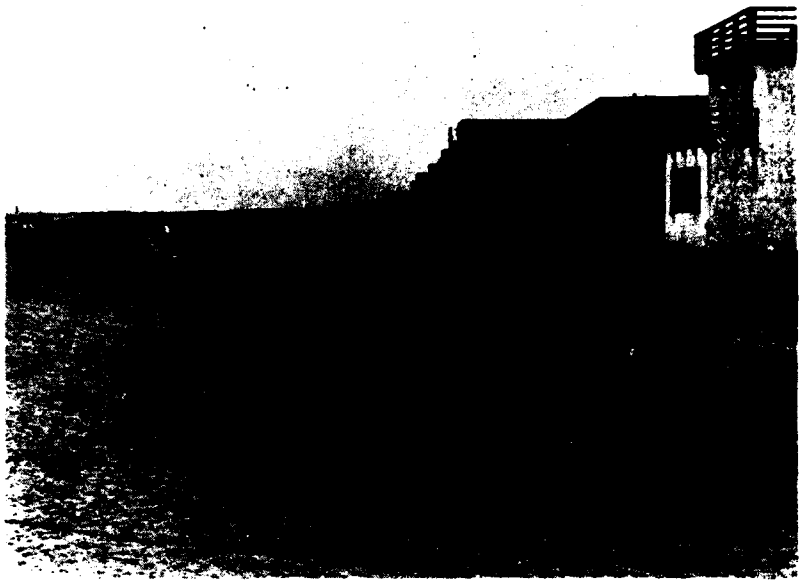


Photo 5. Looking north from Palm Avenue (June 1977).

Photo 6. Looking south from Palm Avenue (June 1977).

Photo 7. Looking north from Coronado Avenue (June 1977).

Photo 8. Looking south from Coronado Avenue (June 1977).

describing beach conditions. Appendix B, "Littoral processes study," discusses these factors in detail.

NATURAL SEDIMENT

The native sand is fine-grained with a median grain size of about 0.20 millimeter (mm) with 16 percent finer than 0.16 mm and 84 percent finer than 0.25 mm.

BEACH FILL

About 1,100,000 cubic yards of sand dredged from San Diego Harbor were placed along 5,000 feet of Imperial Beach shoreline between April and June 1977 (photos 5 through 8).

The Los Angeles District obtained two sets of samples of sediment from the bottom of the San Diego Bay in the area to be dredged (Sweetwater Channel area) for use as beach fill; the first set of 10 samples in 1972 and the second set of 10 samples in 1976. Mechanical analysis of the 1972 samples indicated a median grain size of about 0.07 millimeter. Analysis of the 1976 samples (from a location where the surface layer had been removed) revealed a median grain size of about 0.20 millimeter. A composite of both sets of these data produced a material with a median grain size of about 0.12 millimeter. Because the dredged fill material was well mixed, this composite sample is considered to be representative of the beach fill material.

Littoral forces

Waves, currents, winds, storms, storm surge, tsunamis, ice conditions, and tides are important factors in determining littoral conditions. A detailed discussion of these factors appears in appendixes A, B, and C.

WAVES

Westerly waves approach the project site through three sectors, all having exposures of about 7 degrees. Southerly waves approach from a maximum 40-degree sector. In deep water, most waves from both western and southern directions approach the project site in a net upcoast direction. Longshore currents resulting from the waves impinging on the shoreline at an oblique angle are responsible for the transport of beach material. The net longshore component of wave energy is upcoast--south to north at the project area--because of the predominant upcoast wave characteristics (height, period, frequency of occurrence, and energy). A detailed discussion of the physical factors that influence these characteristics appears in appendixes A, B, and C.

CURRENTS

The Tijuana River and estuary directly affect the littoral movement of material at Imperial Beach by runoff-velocity currents during a major flood but not by tidal flushing. Ocean currents are not known to affect shore conditions in the Imperial Beach area.

WINDS

The average annual wind speed in the San Diego Harbor area is 6.7 miles per hour with a prevailing direction of west-northwest. In November 1944, the maximum wind was recorded at 51 miles per hour from the southeast. Strong winds and gales are infrequent in this region. Velocities over 30 miles per hour average only about once a year.

STORMS

Local storms, extratropical storms, Mexican tropical storms, and Antarctic storms are the most frequent storm conditions that generate waves reaching the southern California coastline. Local storms producing northerly to westerly waves occur during any season of the year; whereas local storms producing southerly waves tend to occur during the winter months. Local storms produce short-period waves of 10 seconds or less.

Extratropical storms originating in the north Pacific generally occur during the late fall, winter, and early spring months and produce northerly to westerly waves with periods between 10 and 18 seconds.

Mexican tropical storms, which originate off the Mexican coastline, and Antarctic storms generally produce southerly waves with periods between 12 and 20 seconds. These waves usually occur during the late spring, summer, and early fall months.

STORM SURGE

Storm surge is an increase in water level that is due to wind-induced currents and the difference in atmospheric pressure over the water surface. Storm surge is relatively small along the southern California coast when compared with tidal fluctuations. About 0.6 foot is considered reasonable for a storm surge height in this area.

TSUNAMIS

Tsunamis, commonly referred to as tidal waves, are long-period waves caused by seismic disturbances or by volcanic action. No damage along the Imperial Beach shoreline from tsunamis has been reported nor is any anticipated, based on Technical Report H-74-3, "Type 16 Flood Insurance Study: Tsunami Predictions for Pacific Coastal Communities," prepared by the U.S. Army Engineer Waterways Experiment Station, dated May 1974.

ICE CONDITIONS

The warm temperatures of the Mediterranean-type climate in this region preclude the formation of ice in the shore area.

TIDES

The tides along the Pacific coast have a semidiurnal inequality. The mean tidal range is the difference in the height between mean high water (MHW) and mean low water (MLW). The diurnal range is the difference in the height between mean higher high water (MHHW)

and mean lower low water (MLLW). The mean tidal range is 3.7 feet, and the diurnal range is 5.3 feet. The tidal extremes are from minus 2 feet to plus 8 feet, with the mean tidal level at plus 2.8 feet. The datum is MLLW.

INVESTIGATIONS

Site

Los Angeles District personnel made numerous observations of wave and surf conditions, shoreline configurations, and other factors pertinent to the problem at Imperial Beach and the surrounding areas. Various local agencies provided data on specific items, such as beach attendance, tributary population, resources, industries, ownership, and development of the shore.

Hydrography and topography

Between 1937 and 1975, the Los Angeles District conducted at least 10 hydrographic and topographic surveys of Imperial Beach and the surrounding coastline. The Los Angeles District used the 1937, 1946, and 1954 surveys for preparing maps and charts in the project document showing shoreline profiles, coastal contours, and volume changes. Aerial photographs were also used.

Volume

The analysis of the volumetric data presented in the project document was based on the following surveys: 1937, 1946, and 1954. Volume computations, based on the 1937 and 1946 surveys carried to a depth of 30 feet below MLLW, show net erosion in the project area of 65,300 cubic yards per year, of which 23,900 cubic yards are above MLLW and 41,400 cubic yards are below MLLW. The deposition of the dredge material from San Diego Bay in the years between 1941 and 1946 on the Silver Strand had no effect on the volumetric changes at Imperial Beach, according to the project document. Volume computations, based on the 1946 and 1954 surveys carried to a depth of 30 feet below MLLW, show a net erosion of 92,500 cubic yards per year, of which 29,200 cubic yards are above MLLW and 63,300 cubic yards are below MLLW. Based on the project document and additional surveys since its completion, an average annual rate of erosion of 30,000 cubic yards has been determined for the Imperial Beach shoreline based on hydrographic surveys taken between 1937 and 1975. A detailed analysis is in appendix B.

Littoral processes

The Intersea Research Corporation prepared a report entitled "Nearshore Processes Along the Silver Strand Littoral Cell," dated 15 August 1974, for the Los Angeles District. Appendix A details this discussion of the littoral processes; and appendix B provides another detailed analysis of the littoral processes at Imperial Beach. The following paragraphs summarize these appendixes.

WAVES

The statistical wave data used indicate the presence of very frequent but low amplitude southern hemisphere swell. The dominant energy source is northern hemisphere swell from 295-315 degrees and with periods of 6-10 seconds. Refraction of waves causes a convergence of energy in the area of the Tijuana Shoal, particularly for those waves approaching from a northern direction. There is a divergence of wave energy for the rest of the littoral cell.

LITTORAL TRANSPORT

The longshore transport calculations show a southern transport at the Silver Strand State Beach, the U.S. Naval Radio Station, and the international boundary, and a northern transport at the U.S. Naval Amphibious Base, Coronado. According to observations and previous studies, a northern transport is expected in the Silver Strand area above the Tijuana River mouth and a southern transport below it. The potential net litoral rate at Imperial Beach has been calculated to be 100,000 cubic yards per year in a northern direction.

The principal natural source of sediment to the Silver Strand littoral cell was formerly the Tijuana River. Measurements and historic records show that the river used to flood periodically and would bring about 700,000 cubic yards per year to the coastline. However, the damming of the Tijuana River Basin and the lack of sufficient precipitation in recent years to cause significant flooding have reduced this natural source of sediment. Consequently, since 1940, the dredged material placed along the strand had been the artificial source of sand to the littoral cell.

Sand introduced to the coast at the mouth of the Tijuana River under natural conditions was divided in transport directions between northern transport through the Silver Strand littoral cell and southern transport into Mexico. Longshore transport to the south into Mexico has been estimated at 600,000 cubic yards per year based on the transport calculations at the international boundary. The remainder of the sand introduced naturally and that sand artificially placed on the Silver Strand is ultimately transported northward along the strand. The longshore transport calculations for the sites along the Silver Strand indicate large transport to the north in the summer and to the south in the winter. However, the movement of fill placed on the strand indicates net transport to the north that probably varies in intensity from year to year. Once sand reaches the northern end of the Silver Strand, some is impounded on the east side of the Zuniga Jetty in the Zuniga Shoal. The remainder enters the San Diego Bay entrance channel where it is transported offshore by ebb tidal currents to an area of accretion on the shallow shelf. Because the natural sand source of the Tijuana River no longer supplies the cell, the principal problem causing beach erosion is the lack of a continuing sand source to supply the longshore transport demands of the local wave regime. This problem has naturally manifested itself first nearest the sand source area or in the vicinity of Imperial Beach.

Geology

Imperial Beach is on the lowermost of a series of flat coastal terraces off the south end of San Diego Bay. The terrace and the immediate ocean area consist of Pliocene age San Diego formation overlain by alluvium. On the terrace, the alluvium is several feet thick, consisting of Pleistocene age dense silty sands and sandy clays. In the ocean, Recent age alluvium is at least 5 feet thick capping the San Diego formation and possibly an unknown thickness of

the older alluvium. The Recent age deposits are unconsolidated sands with some silts and pebbles, apparently originating from the Tijuana River and other sources further downcoast. Appendix E contains a detailed analysis of the geology.

Environmental studies

Biologist divers from the Corps of Engineers and the U.S. Fish and Wildlife Service surveyed the Imperial Beach project study area between October 1976 and April 1977. San Diego State University completed a 1-year "Biological Baseline Study of Imperial Beach Erosion Control Project" area in February 1977 for the Los Angeles District. This study consisted of a series of inventories and surveys of the flora and fauna of several habitats within the study area. The U.S. Army Coastal Engineering Research Center (CERC) also has underway a study of the fauna of sandy beaches at Imperial Beach. This study, which began in August 1976 and will continue through March 1978, was designed to determine the fauna of a natural beach so it might be compared to a beach during and after sand nourishment and to describe the faunal populations in relation to physical parameters. A continuation study of the sandy beach fauna is proposed for 1978-79 to determine ecological relationships of sandy beach fauna following stabilization of a previously nourished beach. Completed reports and species lists are available at the Los Angeles District Office. The Imperial Beach Environmental Impact Statement provides detailed information on the environmental setting of the project study area and discusses impacts of the proposed project. A previous section in this report, titled "Environmental setting," summarizes the environmental setting of the project study and a later section, titled "Environmental impacts of the recommended plan," summarizes the impacts.

PLAN FORMULATION

General

The formulation and evaluation of a plan, including the screening of alternatives, must of necessity be within the context of an appropriate set of formulation and evaluation criteria. Such criteria, both technical and economic, intangible considerations, and also the desires of local citizens and groups permit the development and selection of a plan that best responds to the problem and needs and that is justifiable.

TECHNICAL CRITERIA

The following technical criteria were adopted for use in formulating a plan:

a. Protection should be provided for the recreational beach against erosion.

b. Protective works should provide protection for public and private property, public utilities, and structures.

c. Protective works should provide protection of Federal property.

d. Protection against beach erosion should be permanent, that is, for the life of the project.

ECONOMIC CRITERIA

Benefits from shore protection projects are derived from: (1) increased recreational beach use; (2) prevention of beach erosion damages to land and improvements; and (3) land enhancement.

Economic criteria are:

a. Each separate unit of improvement or purpose must provide benefits at least equal to the costs unless otherwise justified on an intangible basis.

b. The period of analysis and the interest rate shall be 50 years and 2-5/8 percent, respectively.

c. The benefits and costs shall be expressed in comparable terms based on March 1978 price levels. Annual costs shall include operation and maintenance costs.

d. Project benefits shall be based on an analysis of conditions with and without a project utilizing the methodology described in this report.

e. The scope of development shall be such as to provide the maximum net benefits; however, environmental quality and intangible considerations could dictate a project that forgoes some of the tangible benefits.

To determine recreational beach use benefits, it is necessary to calculate the anticipated daily peak and the total annual use over the life of the project in order to fully assess the recreational benefits. Use figures are generally derived from the recorded beach use in the adjacent or nearby beach areas that offer similar conditions such as access, parking, and location.

To determine the benefit from prevention of damages in the form of loss of land and improvements, it is first necessary to estimate the average erosion rate that might be expected on the basis of historic evidence of shoreline changes. From this, the areal extent of loss of land can be determined on the basis of the life of the shore protection project, which is 50 years. Estimated benefits from prevention of damages to land and improvements located within the anticipated damaged area are based on the market value as of March 1978.

Land enhancement benefits are based upon the increase in value of private land in the project areas resulting from the proposed project improvements. The increase in value of the private land results from the increase in development potential of the land and is attributable only to the land, and not to the structure. All land to be protected by the alternatives is already developed. No land enhancement benefits accrue to any of the alternatives.

ENVIRONMENTAL AND OTHER CONSIDERATIONS

The following intangibles were considered in formulating a plan:

a. Public health, safety, and social well-being, including possible loss of life.

b. Provision of pleasing esthetic and other desirable environmental effects or features.

c. Avoidance or mitigation of detrimental environmental effects.

d. Coordination with interested Federal and non-Federal agencies, various groups, and individuals through cooperative efforts, meetings, public hearings, and other procedures.

e. Desires of the local interests.

Model study

GENERAL

Because of the present study encompassed alternatives not of original intent and the available technical data were inadequate to evaluate several specific designs of these new alternatives, the U.S. Army Engineer Waterways Experiment Station made a hydraulic model study of the Imperial Beach shoreline from September 1975 through August 1977. This study investigated the arrangement and design of structures for protection of the shoreline from erosion. The entire study consisted of two models–a three-dimensional and a two-dimensional–as described below.

THREE-DIMENSIONAL MODEL

The three-dimensional model was an undistorted 1:75 scale model reproducing about 2.6 miles of shoreline and sufficient offshore area to permit generation of the required test waves. Tests were performed on the existing conditions, which were characterized by strong rip and longshore currents for most wave conditions, with considerable onshore-offshore movement of sand. These existing conditions were then used as a base to compare the relative efficiency of the following alternatives tested: the authorized five-groin plan; continuous breakwaters at the minus 15- and 10-foot contours; saw-toothed breakwaters at the minus 10- and 5-foot contours; segmented breakwaters at the minus 15- and 5-foot contours; and 2 nine-groin systems. The authorized plan was shown to be ineffective in trapping tracer material, and, in fact contributes to the offshore movement. The breakwaters at the minus 5- and 10-foot contours appeared to be more effective than the ones at the minus 15-foot contour. The breakwaters at the minus 5-foot contour appear to have the least hindrance on the longshore transport. Appendix F contains a detailed analysis of the three-dimensional model study.

TWO-DIMENSIONAL MODEL

The two-dimensional model study was an undistorted 1:16 scale model aimed at developing engineering criteria for the structural stability of submerged and highly overtopped breakwaters. The study was to establish the least costly stable cross section based on the maximum possible breaking wave at the water depth where the breakwater would be located. The results of this study were used for the recommended plan. Appendix G analyzes this study in detail.

ALTERNATIVES

General

The problem of beach erosion at Imperial Beach has many alternative solutions. None of the alternatives includes the initial placement of beach material because the Imperial Beach area has already received beachfill from the San Diego Harbor deepening project. The recommended plan would stabilize this beachfill. This will not preclude consideration of periodic nourishment as an alternative.

The Imperial Beach area experiences what is known as a summer beach and a winter beach. A beach that has accreted because of the influence of longer period waves, which usually take place in the summer, is known as a summer beach. A beach that has eroded because of shorter period waves, which usually occur during the winter, is known as a winter beach. Therefore, in order to protect and maintain the maximum beach, the recommended plan should be constructed in late summer to take advantage of the summer buildup of the beach. These alternatives are introduced and briefly discussed in the following paragraphs.

Five groins

This alternative, which is the authorized project in the document plan, would build five groins in the project area. The groin compartments would fill by natural accretion, thus restoring the recreational beach and providing shoreline protection. Two of the five groins were constructed and the compartment between them did not fill. Therefore, it was determined that further implementation of this alternative would not solve the problem of beach erosion.

No action

This alternative would leave the Imperial Beach shoreline as it is.

Condemnation and relocation

This plan would condemn property for public use and relocate residents and improvements to other areas.

Offshore vegetation (natural-artificial)

This alternative involves the planting or placement of natural or artificial vegetation; most likely, kelp. The natural kelp would be planted offshore and left to grow to the surface, dissipating the wave energy. The artificial kelp would be fastened to the bottom through a system of mesh.

Sand fencing

This plan would build sand fences onshore to trap wind-blown sand; thus, in a matter of time, restoring the beach. This method works best in extremely windy areas and in areas where there is already a wide sandy beach.

Seven groins

This plan would construct five rubblemound groins placed at the same locations as those in the project document, plus two additional downcoast groins. These groins would be longer than the authorized groins. This method has worked well in areas with up-and-downcoast littoral movement. (See pl. 1.)

Nine groins

This alternative would construct seven new rubblemound groins and extend the two existing groins, spaced at a closer interval than the seven-groin alternative. The groins would be shorter than those mentioned in the previous paragraph. This method has also worked well in areas with up-and-downcoast litoral movement. (See pl. 2.)

Revetment

This plan would place rubblemound revetment fronting the Imperial Beach shoreline structures. This plan would protect the structures from wave runup, but would not maintain the recreational beach.

Periodic beach nourishment

This alternative would deposit beach sand at intervals adequate to protect the shoreline structures and to maintain a recreational beach. This plan would protect the shoreline structures and maintain the recreational beach.

Offshore surface-piercing breakwater

This alternative would consist of a continuous or segmented offshore rubblemound structure that would extend above the waterline. This plan would solve the problem of beach erosion and would maintain the recreational beach. (See pl. 3.)

Submerged offshore breakwater

A submerged offshore breakwater, either continuous or segmented, would be constructed of rubblemound parallel to shore and would come to an elevation below the water surface. This plan would also solve the problem of beach erosion and would maintain the recreational beach. (See pl. 4.)

ANALYSIS OF ALTERNATIVES

An analysis of all the alternatives resulted in detailed analyses of the plans that appeared to be the most viable. The authorized five-groin plan was not considered in this analysis because the model study results showed that it would be ineffective in stabilizing the beach. Condemnation and relocation, offshore vegetation, sand fencing, and revetment were not considered in further analysis because they did not meet the major project purpose of beach stabilization. The following paragraphs summarize the analyses of the no-action and the viable alternatives.

No action

This alternative would do nothing to maintain the recreational beach or to protect private and public properties. It would not satisfy the project purposes, since the beach would continue to erode and eventually damage would occur to the property fronting the beach.

Seven groins

Five rubblemound groins would be constructed at the same locations as those in the project document, along with two additional downcoast groins that would be constructed on at least the minus 15-foot contour. Analysis of this plan indicated that it would afford adequate beach stabilization to satisfy the project purposes. Although this plan is economically justified, yielding a benefit-cost ratio of 2.9 to 1.0, it would be esthetically unpleasing and would compartmentalize the recreational beach. Local support for this plan is minimal.

Nine groins

Seven new rubblemound groins would be constructed and the two existing groins extended. The groins would be constructed to the minus 12-foot contour and would be spaced at a closer interval than in the seven-groin alternative. Testing in the hydraulic model indicated that the plan would provide very good protection to the recreational beach. With a benefit-cost ratio of 2.6 to 1.0, the plan is economically justified. It would, however, be esthetically unpleasing and would compartmentalize the recreational beach. Local support for this plan is minimal.

Periodic beach nourishment

Beach sand would be deposited at intervals adequate to protect the shoreline structures and to maintain a recreational beach large enough to meet the recreational demand. An investigation concluded that the most viable long-term source of beach material is the Zuniga Shoal. This plan has a benefit-cost ratio of 2.0 to 1.0, and it satisfies the project purposes.

Offshore surface-piercing breakwater

This plan would involve construction of a continuous or segmented structure that would extend above the water surface. Structures of this nature have worked well in several places throughout the world. Numerous variations of this plan were tested in the hydraulic model. The plan that afforded the best protection with the least impact on the adjacent shoreline was a continuous breakwater with alternating high and low segments situated at the minus 5-foot contour. The breakwater would be visible at all times. The benefit-cost ratio is 3.1 to 1.0. Local interests were favorable toward this alternative, and it would maintain the recreational beach.

Submerged breakwater

A continuous or segmented structure that would extend to an elevation below the water surface would be constructed. It is believed that structures of this type have not been constructed previously for the purpose of beach erosion control. Testing of numerous

variations of this plan in the hydraulic model resulted in one plan that afforded the best protection. This was a continuous breakwater with alternating high and low segments situated at the minus 10-foot contour. The benefit-cost ratio is 3.6 or 4.5 to 1.0 depending on length. The breakwater would be submerged, which makes this plan esthetically pleasing, and it would provide for new rocky shore habitat. Local interests are in strong support of this plan, which would maintain the recreational beach and which satisfies the project purposes.

PUBLIC LAW 91-611 ANALYSIS

Table 1 gives the preconstruction, construction, and postconstruction effects of each alternative as required by Section 122 of Public Law 91-611.

TABLE 1

Section 122 of Public Law 91-611 Analysis

Alternatives (As Compared to No Action).

Effects	No Action	7 Long Groins	9 Groins	Periodic Beach Nourishment	Offshore Surface-Piercing Breakwater	Submerged Offshore Breakwater
Noise*	Decrease in noise due to fewer visitors in project area.	Increase during construction and afterwards due to increase in visitors.	Same	Increase during placement and afterwards due to increase in visitors.	Increase during construction and afterwards due to increase in visitors.	Same
Displacement of people*	Displacement will occur eventually.	Delay or prevention of displacement of people.	Same	Same	Same	Same
Esthetic values*	Beach vista will eventually change (if erosion rate is not arrested) since houses fronting beach will be destroyed due to erosion.	Changes beach vista to one with more recreation beach and calmer water.	Same	Changes beach vista to one with more recreational beach.	Same	Same
Community cohesion*	See text.	Same	Same	Same	Same	Same
Community and regional growth*	Hampers beachfront and backshore growth.	Facilitates beachfront and backshore growth.	Same	Facilitates beachfront and backshore growth.	Same	Same

*Study of effects required by Section 122.

NOTE: The word "same" in each column refers to the information contained in the column to the left of it.

TABLE 1 (Continued)

Effects	No Action	7 Long Groins	9 Groins	Periodic Beach Nourishment	Offshore Surface-Piercing Breakwater	Submerged Offshore Breakwater
Tax revenues*	Revenues will eventually decrease since economic growth will be stunted.	Revenues will increase since this project will stimulate economic growth.	Same	Same	Same	Same
Property values*	Values will decrease since area will become a less desirable place to live and establish new businesses.	Values will increase since area will become a more desirable place to live and establish new businesses.	Same	Same	Same	Same
Local/regional activity and land uses*	Decrease in local/ regional activity.	Increase in activity and a change in land uses to types that will stimulate economic growth.	Same	Same	Same	Same
Public facilities and services*	Decrease in usage due to less visitors.	Increase in usage due to increase in visitors.	Same	Same	Same	Same
Employment labor force*	Eventual decrease in the number of jobs near the project area since no action will stunt economic growth in the area.	Temporary increase in full time jobs during construction and an increase in recreation tourist related jobs after project completion.	Same	Same	Same	Same
Population	Decrease due to a decline in local/ regional activity.	Increase due to an increase in local/ regional activity.	Same	Same	Same	Same

*Study of effects required by Section 122.

NOTE: The word "same" in each column refers to the information contained in the column to the left of it.

TABLE 1 (Continued)

Effects	No Action	7 Long Groins	9 Groins	Periodic Beach Nourishment	Offshore Surface-Piercing Breakwater	Submerged Offshore Breakwater
Housing	Due to a decrease in local/regional activity housing construction will be stunted.	Although there will be an increase in population, multiple units and condominiums will be built rather than more single family units.	Same	Same	Same	Same
Archeological resources/ historical structures	To be addressed by EIS.	Same	Same	Same	Same	Same
Transportation	Eventual decrease in traffic due to a decrease in visitors and resident population.	Increase in traffic due to an increase in visitors and population.	Same	Same	Same	Same
Educational opportunities	No impact	Same	Same	Same	Same	Same
Leisure opportunities	Decrease in recreational opportunities due to safety hazards.	Increase in "on-beach" activities but a decrease on surfing opportunities due to calmer water. See text.	Same	Increase in "on-beach activities.	Increase in "on-beach" activities but a decrease in surfing opportunities due to calmer waters. See text.	Same
Cultural opportunities	No impact	Same	Same	Same	Same	Same

NOTE: The word "same" in each column refers to the information contained in the column to the left of it.

TABLE 1 (Continued)

Effects	No Action	7 Long Groins	9 Groins	Periodic Beach Nourishment	Offshore Surface-Piercing Breakwater	Submerged Offshore Breakwater
Institutional relationships	May strain working relationships among agencies involved as city would lose revenue under this alternative.	Agencies are willing to cost share 57% Federal and 43% local. Project will encourage increased residential and commercial building, which will then increase revenue to agencies that cost shared.	Same	Same	Agencies are willing to cost share 57% Federal and 43% local. Project will encourage increased residential and commercial buildings, which will then increase revenue to agencies that cost shared. City will be responsible for maintenance of alternative.	Same
Health and Safety	Eventual increase in health and safety hazards.	Increase in safety for recreationists and beachfront residents.	Same	Same	Same	Same
National economic development	Annual loss of property of $37,000 at 2-5/8%; less of 625,000 square feet of recreational beach.	$254,000 @2-5/8 percent interest 50-year life.	$238,000 @2-5/8 percent interest 50-year life.	$190,000 @2-5/8 percent interest 50-year life.	$263,000 @2-5/8 percent interest 50-year life.	$268,000 @2-5/8 percent interest 50-year life.

NOTE: The word "same" in each column refers to the information contained in the column to the left of it.

TABLE 1 (Continued)

Effects	No Action	7 Long Groins	9 Groins	Periodic Beach Nourishment	Offshore Surface-Piercing Breakwater	Submerged Offshore Breakwater
Local public costs	If no action is taken, the costs of protecting the structures fronting the beach will be born by the private owners of the structures.	See table 2.	Same	Same	Same	Same
Real income distribution	No effect.	Same	Same	Same	Same	Same
Business/industrial activity	Decrease in activity.	No impact.	Same	Same	Same	Same
Agricultural activity	No impact.	Same	Same	Same	Same	Same
Food supply	No impact.	Same	Same	Same	Same	Same

NOTE: The word "same" in each column refers to the information contained in he column to the left of it.

Coordination with others

All proposals by local interests, as well as by other Federal and State agencies, were reviewed and considered during the plan formulation studies. These proposals were reviewed and developed through meetings with local interests.

Three public meetings–19 May 1966, 27 November 1973, and 7 June 1978–were held to gain local input and to consider public sentiment toward project implementation. Congressman Lionel Van Deerlin and representatives from Federal, State, county, and city agencies, and the local news media attended these meetings.

At the public meeting on 19 May 1966, the District Engineer first defined the erosion problem and then explained the authorized project and its partial implementation. He also stated the purpose of the investigation was to determine if there were a feasible and economically justifiable plan to improve the effectiveness of the groin field already authorized and to extend protection to other areas of new development. The District Engineer solicited public participation in developing alternative plans for beach erosion control. Local citizens expressed their concern over the erosion problem and urged the Corps of Engineers to develop a solution as soon as possible.

At the public meeting on 27 November 1973, the Acting District Engineer reviewed the existing project and explained the procedures that would be forthcoming to implement the most viable alternative. Fourteen possible alternatives were presented and discussed. Local interests again expressed their concern over the erosion problem and urged early implementation of a solution.

At the public meeting on 7 June 1978, the Acting District Engineer presented a brief history of the project and a discussion of the alternatives investigated was given. A discussion of the model was also given. The presentation was concluded with the recommendation for the offshore submerged breakwater. Statements from Congressman Van Deerlin and Mayor Bilbray were submitted for the record in support of the project. Opposition to the project was raised by a small group of surfers because of the reduction of waves.

At the public workshop meeting on 13 April 1977 in Imperial Beach, Los Angeles District representatives presented the results of the engineering, economic, and environmental studies. State, county, city, and local citizenry were represented. On 19 April 1977, the Imperial Beach City Council expressed its support and recommendation for the submerged offshore breakwater alternative.

At a public workshop meeting on 28 June 1978 a presentation was made on the hydraulic model study. Here again a small group of surfers raised opposition to the project. Several questions were asked about the feasibility of incorporating a small craft harbor facility with the project. It was explained that this was not a project purpose and it would be unfeasible to incorporate a small craft facility with this project. Many local citizens supported the project and urged that the project be completed as soon as possible.

During preparation of the draft environmental impact statement and general design memorandum, formal coordination was conducted with all agencies and interests known to be concerned or interested in the project.

SELECTING A PLAN

Selecting the best plan of improvement for the project area involved determining which plan best satisfied the engineering, economic, social, and environmental criteria, and the intangible considerations applicable to plan formulation. Extensive studies were made of the authorized five-groin plan. These studies indicated this plan was ineffective in stabilizing and maintaining a recreational beach at Imperial Beach. Therefore, another alternative solution would have to be selected.

The economic criterion applicable to formulating and selecting a plan is that the tangible benefits exceed the project economic costs. In this case, most benefits are recreational, with some benefits from the protection of public and private property from damage. The economics of all engineeringly feasible alternatives are summarized in tables 2 and 3.

Other factors that affected the selection of the recommended plan included: (a) the environmental impacts of the plans; and (b) the expression of comments and desires from other agencies and organizations, the general public, and the governing board of the local entity—the City Council of Imperial Beach.

The costs for the various viable alternatives vary significantly, as can be seen in table 3; the recreational benefits, however, are the same.

TABLE 2. Economic summary, Imperial Beach
($1,000, 2-5/8%; 50-year life)

Alternative	Equivalent annual benefits	Equivalent annual costs	Benefit-cost ratios	Net annual benefits
No action	–	*	*	*
7 Long groins	505	189	2.7	316
9 Groins	505	205	2.5	300
Periodic beach nourishment	505	198	2.6	307
7,000-foot offshore surface-piercing breakwater	505	148	3.4	357
7,000-foot submerged offshore breakwater	505	140	3.6	365
5,000-foot submerged offshore breakwater**	502	112	4.5	390

*See section titled "Apportionment of costs."
**Discussed in section titled "Incremental analysis of selected plan."

TABLE 3. Equivalent annual charges,* Imperial Beach.
(In thousands of dollars.)

	No action**	Seven long groins	Nine groins	Periodic beach nourishment	7,000-Foot offshore surface-piercing breakwater	5,000-Foot submerged offshore breakwater	7,000-Foot submerged offshore breakwater
Total project first cost	–	4,269	4,633	5,478	3,345	2,560	3,169
Annual charges							
Construction of alternative	–	154	167	198	121	93	115
Operation and maintenance							
Non-Federal	–	35	38	0	26	18	24
Federal	–	0	0	0	1	1	1
Total annual	–	189	205	198	148	112	140

*2-5/8 Percent interest, 50-year life, capital recovery factor = 0.036144.
**If no action is taken a total of $2,667,000 in public and private property will be subject to loss.

The environmental aspects of all the alternatives are discussed in the draft environmental impact statement, Imperial Beach, California. All the viable alternatives, except the periodic nourishment habitat alternative, would cover some sandy bottom habitat and would create rocky shore habitat.

Based on engineering, economic, social, and environmental considerations, as well as the desires of local interests, the submerged offshore breakwater alternative was selected as the recommended plan. More specifically, it is recommended because it:

a. Provides the best protection to the beach and to adjacent property.

b. Provides the largest amount of net benefits.

c. Provides a highly stable beach.

d. Has a minimum of adverse environmental impacts, as well as some beneficial environmental impacts.

e. Is acceptable to the general public.

f. Is the most acceptable esthetically because no structure will be seen above MLLW.

g. Is the most acceptable socially because the location of the proposed submerged offshore breakwater provides the greatest amount of calm water for swimming.

INCREMENTAL ANALYSIS OF SELECTED PLAN

An incremental analysis of the submerged offshore breakwater was made to determine what length would provide the greatest net benefits, and, hence the greatest economic justification. At 2-5/8 percent interest, 50-year project life, net benefits maximized at a breakwater length of 3,000 feet. Strictly based on economic efficiency, the optimal length should be 3,000 feet. Certain other parameters, however, were included to determine the recommended length of 5,000 feet. First, existing sand on the beach extends for 5,000 feet. Failure to protect this beach material will result in its loss from the beach. Replacement of the sand would be extremely difficult because of the lack of clean dredge material and the cost of dredging. Second, under existing conditions, the main public parking lot providing off-street parking is located in the portion of the beach protected by a 5,000-foot breakwater but not protected by a 3,000-foot breakwater. In addition to the available parking, the provision of fire rings, restrooms, and other service facilities in this 2,000-foot increment makes it the most popular part of the beach. Third, while the beach is expected to erode at an average rate of 4 feet per year, large storms could eliminate the entire 125-foot beach width in a few years, exposing the adjacent homes to almost immediate danger of damage, as shown by storms which hit in October 1977 and February 1978, eroding 75 feet of beach. For those reasons, the 5,000-foot breakwater is selected in lieu of the more economical 3,000-foot length.

DESCRIPTION OF THE RECOMMENDED PLAN

The project plan recommended in this report contains structural measures to maintain the recreational beach and to protect public utilities, private property and structures, and U.S. Naval facilities. The recommended plan is discussed in detail in this section.

Submerged offshore breakwater

The recommended plan consists of a breakwater constructed parallel to the shoreline roughly following the minus 10-foot MLLW contour. This location is about 600 to 700 feet seaward from the berm. The breakwater would be 5,000 feet long, extending southward from the northern groin. It would consist of alternating high and low segments, each 715 feet long. The high segments would have a crest elevation of 0.0 ft MLLW and the low segments would have a crest elevation of minus 5 feet MLLW. The northern groin would be extended approximately 100 feet to connect with the breakwater, and a 600-foot long, 5-foot-high groin would be built from the shoreline to the southern end of the breakwater. The high segments would be composed of a conglomerate mixture of stone, having a maximum size of 7 tons; and the low segments would also be a conglomerate mixture of stone, having a maximum size of 5 tons. The breakwater would be placed on a plastic filter blanket to prevent sand from percolating into the structure. The plastic filter cloth would initially be held in place by 0.5-ton stone. This stone would ultimately serve as toe protection for the breakwater. The quantities of rock needed are 76,870 tons for the high segments and the northern groin extension, 25,610 tons for the low segments and the southern groin, and 11,170 tons for toe protection. The cost estimate for the recommended plan is shown in table 4. The beach would build up behind the high segments and would erode behind the low segments, but the amount of buildup or erosion would not be large enough to endanger the structure. Also, the total area of beach would not change. On both ends of the breakwater and on the end of the fishing pier would be navigation lights. The recommended plan is shown on plate 5.

TABLE 4. Recommended plan cost estimate.

Item	Unit	Quantity	Unit Price	Amount
Mobilization and demobilization of equipment	LS			$57,000
Stone				
7-Ton conglomerate	Ton	76,870	$13.00	1,000,000
5-Ton conglomerate	Ton	25,610	13.00	333,000
0.5-Ton stone	Ton	11,170	13.00	145,000
Plastic filter cloth	Ft^2	334,400	0.12	40,000
Subtotal				1,575,000
Contingencies (15 percent)				240,000
Navigational aids	Each	3	9,000.00	27,000
Total project construction cost				1,842,000
Engineering and design				535,000
Supervision and administration				183,000
Total project first cost				$2,560.000

COST ESTIMATE

The cost estimate for the recommended plan does not include the sunk costs of $157,000 that were expended between 1959 and 1963 for the construction of the two existing groins.

The costs in the estimate were based on discussions with contractors having experience in the type of construction anticipated. It is anticipated that the breakwater would be constructed utilizing barges. The rock would be brought to the project site on barges and off-loaded utilizing a crane. The cost estimate for the plastic filter cloth in place is based on discussions with several suppliers.

The following tabulation shows the current project estimate, the authorized project estimate, and the latest approved estimate. Sunk costs are included with these estimates for comparison only.

	Recommended project (Mar 78 PL)	Authorized project (Feb 56 PL)	Latest approved estimate (Oct 78 PL)
Federal	$1,470,000	$27,800	$1,531,000
Non-Federal	1,090,000	59,200	1,132,000
Sub-Total	$2,560,000	$87,000	$2,663,000
Federal sunk cost	69,000	69,000	69,000
Non-Federal sunk cost	88,000	88,000	88,000
Total	$2,717,000	$244,000	$2,820,000

The difference between the recommended project estimate and the authorized project estimate is attributed to the increase in construction cost of the submerged breakwater versus the authorized groin plan and cost escalation. The difference between the recommended project estimate and the latest approved estimate is attributed to price-leveling.

SCHEDULE FOR DESIGN AND CONSTRUCTION

It is anticipated that it would take approximately 4 months to construct the breakwater and groins. If funds are made available the plans and specifications could be completed in fiscal year 1979. Construction could be initiated and completed in fiscal year 1979 and would require $911,000 in federal funds for that year. The construction of the breakwater would be performed by a private contractor.

ECONOMIC ANALYSIS OF THE RECOMMENDED PLAN

The tangible benefits associated with the recommended plan can be identified as: (1) increased recreational beach use, and (2) prevention of beach erosion damages to lands and improvements.

Benefits for increased recreational beach use were determined by analyzing the current and projected beach demand for Imperial Beach and projected beach capacity to determine the projected beach shortage without the project. The with project condition maintains the

existing beach capacity, so future benefits are the additional beach visits provided. A user day value of $1.50 was applied to recreational beach use. Equivalent annual benefits for increased recreational beach use amount to $468,000 at 2-5/8 percent, and $233,000 at 6-5/8 percent. The California Department of Finance has changed the baseline population projections they use from D-100 to E-150 series. An application of the new forecasts to the tributary population of Imperial Beach results in a reduction in recreational beach benefits from $468,000 annually to $435,000 annually at 2-5/8 percent, and from $233,000 to $218,000 at 6-5/8 percent. The benefit cost ratio for the recommended plan will be 4.2 to 1 if the revised forecast were used at 2-5/8 percent versus 4.5 to 1 with the old forecasts. At 6-5/8 percent, the plan will have a benefit cost ratio of 1.2 with the revised forecasts versus 1.3 with the old forecasts. No impact on project formulation would result.

Benefits for prevention of beach erosion were determined by assuming a constant erosion rate of 4 feet a year without the project. Total value of public and private lands subject to damage is $2,667,000. These damages do not begin to occur until 2009, and an annual loss of $140,000 occurs for the following 19 years. Within the Imperial Beach project area the recommended plan will provide beach erosion protection for 47 separate parcels. The developments protected include 18 single family homes, 9 multiple unit residences, 2 mobile homes, one motel, and public streets and utilities. Damages to these lands and improvements are estimated at $34,000 annually at 2-5/8 percent and $11,000 annually at 6-5/8 percent.

Damages to property south of Beach Avenue occurs to 22 parcels, with three single family and four multi-family units sustaining beach erosion damage during the project life. These units will be unprotected with implementation of the recommended plan. Annual damages to the land and improvements below Beach Avenue are estimated at $3,000 annually at 2-5/8 percent and $2,000 annually at 6-5/8 percent.

The 5,000 foot submerged offshore breakwater has an equivalent annual cost of $112,000 and annual benefits of $505,000 for a benefit cost ratio of 4.5 to 1. At 6-5/8 percent, equivalent annual costs are $196,000 and annual benefits are $247,000, for a benefit cost ratio of 1.3 to 1. The analysis is based on a 50 year project life.

The following table summarizes the economic analysis:

Imperial Beach Recommended Plan
(50 Year Project Life)

First Cost	$2,560,000	
Annual O & M	19,000	
	2-5/8 percent	6-5/8 percent
Annualized First Cost	$93,000	$177,000
Annual O & M	19,000	19,000
Annual Charges	112,000	196,000
Beach Recreation Benefits	$468,000	$233,000
Damages Prevented	34,000	13,000
Annual Benefits	502,000	246,000
Net Benefits	$390,000	$50,000
Benefit-Cost Ratio	4.5	1.3

OPERATION AND MAINTENANCE

The structural stability of the breakwater was tested in the model study. The structure is considered highly stable and would require a minimum of maintenance. Experience has shown that about 1 percent of the total project construction cost per year is a good estimate for operation and maintenance for a structure of this type. This amounts to approximately $18,000 per year. It is anticipated that there would be a negligible loss of sand from the breakwater system. These funds would be furnished by local interests and would be utilized to repair the breakwater if it were damaged in a storm or to replenish the beach. The U.S. Coast Guard estimates it would require $1,000 per year to operate and maintain its navigation aids.

SHORELINE CHANGES

If the structure were not constructed, the beach at Imperial Beach ,would erode until it depleted the material in the area, at which time the erosion would progress northward. The recommended plan, however, would not have an impact on the adjacent shoreline, since the structure would not impede the longshore transport of littoral materials sufficiently to affect the shoreline on either side of the structure. The shoreline erosion rate along the Silver Strand littoral cell will not be affected by the structure.

SITE EXPLORATION OF FOUNDATION CONDITIONS

Probes were made along the proposed breakwater alinement to determine the suitability of the ocean floor to support the structure. The exploration indicated the foundation for the proposed breakwater consists mostly of gray fine and dense sands overlying an impenetrable zone of hard cobbles that occurs at a depth of 5 to 8 feet. In the vicinity of Coronado Avenue for about a 1,000-foot length, the sand becomes black, very organic, and less dense. The underlying rock zone is also less dense and could be penetrated with the probe. The overall foundation is suitable for the proposed offshore breakwater with a filter layer to restrict sand migration. The structure would be especially susceptible to migration in the less dense section off Coronado Avenue. The nearby groins and pier have similar foundations and show no apparent settlement.

EXISTING QUARRIES

Existing quarries in Otay Valley, Mission Gorge, and Santa Catalina Island can provide suitable stone to over 7-ton size. The McGrath quarry near El Cajon may also provide the required stone for an offshore breakwater, but this source has not been confirmed.

GROUND WATER

Ground water is not a factor in this project. The proposed offshore breakwater would not affect the existing regimen because seawater is already in contact with freshwater aquifers inland from the project.

EARTHQUAKES

Earthquakes are to be expected, but the project is in an area of low seismicity for southern California. Larger earthquakes have been originating in the Imperial Valley region some 40 miles distant. The greatest ground shaking to date in historic time is estimated to have been only 0.05g from Imperial Valley earthquakes, and future events should not exceed 0.1g from either a local or a distant source.

Socioeconomic impacts of the recommended plan

Appendix D presents the existing conditions and projected conditions without the project. Also, table 1 provides Public Law 91-611 analysis. A summary of the socioeconomic impacts of the recommended plan, however, is provided:

The construction of the recommended plan would indirectly stimulate local and regional activity. With the recreational beach present, locals and tourists would visit the beach more frequently, thereby increasing their leisure opportunities and use of public facilities, as well as the traffic congestion. These new beach goers would encounter safer recreational excursions because of the long, wide beach that would replace the irregularly shaped beach. Although construction of the recommended project would improve safety at Imperial Beach by providing calmer waters, surfing within the 5,000-foot project length would be adversely affected. The net effect of construction would be that recreation and tourist-oriented businesses would flock to the beach area to service the influx of new customers. These businesses would not only provide employment, but would also provide additional revenue for city, State, and Federal governments.

Esthetics would be improved as a result of the project and property values would reflect this improvement in higher prices. As the area becomes a more desirable place to live, the population would increase. However, although there would be an increase in population, multiple units and condominiums would be built rather than additional single-family units.

Without a project, locals are forced to provide their own protection for the structures that front the beach. However, agencies are willing to cost-share the recommended project, 57 percent Federal and 43 percent local. Since the project would encourage increased residential and commercial building, tax revenues to the local sponsor would increase.

Construction of the recommended plan would not impact cultural or educational opportunities, food supply, the three sport fishing boats that operate out of the Imperial Beach pier, or agricultural activity.

Environmental impacts of the recommended plan

A detailed environmental impact analysis is contained in the "Environmental Impact Statement for Beach Erosion Control at Imperial Beach." The environmental impacts of the recommended plan are summarized as follows:

a. Dissipation of waves, prevention of beach erosion, and maintenance of existing beach replenishment materials.

b. Protection of existing beach, beachfront structures, public utilities, and the U.S. Naval Radio Station facilities.

c. Local destruction of sedentary bottom species, displacement of mobile species, and loss of sandy subtidal habitat, as well as loss of intertidal sandy beach habitat with construction of the rock groin.

d. Minor alteration of beach and ocean appearance.

e. Creation of new rocky intertidal and subtidal habitat.

f. Inducement to make greater recreational use of Imperial Beach.

g. Possible net impairment of recreational surfing.

h. Consumption of natural resources at the quarry sites.

i. Increased potential for navigation and bathers' and surfers' safety problems with construction of the submerged breakwater and attached groins.

j. Short-term increase in coastal water turbidity during project construction.

k. Temporary increase in truck traffic along with air and noise pollution during project construction.

Section 404(b) Evaluation

Section 404(b) of the Federal Water Pollution Control Act Amendments of 1972 (Public Law 92-500) requires the Corps of Engineers to evaluate proposed deposition of material into waters of the United States. This paragraph addresses that requirement. The fill material will consist of commercial quarry rock placed in sandy-bottom high-energy surf and subtidal zones. Placement of the rock will cause short-term turbidity of the ocean waters in the immediate project area and impact subtidal biota. The submerged breakwater may impact grunion spawning and affect surfacing values. Construction of the submerged breakwater and south groin will not impact existing wetland habitats. No other impacts that relate to Environmental Protection Agency regulations concerning Section 404(b) will result from the proposed action.

MONITORING PROGRAMS

The U.S. Army Coastal Engineering Research Center (CERC) is conducting a number of monitoring programs at Imperial Beach. One is a beach monitoring program; the others are biological studies.

Beach monitoring

The beach monitoring program was initiated in January 1977 and is scheduled to continue until June 1979. It consists of taking hydrographic surveys along the Imperial Beach shoreline, extending out to the minus 30-foot contour, and of taking sand samples

along the shoreline at various elevations. This program is vital because it will indicate what is happening to the beach and the fill material that was placed on it from the San Diego Harbor deepening project. Continuation of this program is essential after the proposed submerged offshore breakwater has been constructed to determine its effects on the beach.

Biological studies

The Corps will continue biological monitoring studies to assess the effects of the project on the immediate project area and nearby environmentally sensitive areas. The Coastal Engineering Research Center (CERC) will continue to monitor the effects of the beach nourishment project at Imperial Beach on the marine environment. This initial biological baseline study report will be completed in March 1978. CERC then plans to continue the study for 1 year, beginning in October 1978. CERC also proposes a 2- to 3-year monitoring study to determine the successional biotic changes that occur on the breakwater and the ecological value and impact of these changes on adjacent habitats. The Los Angeles District Corps of Engineers proposes a 3-year study of the possible impacts of the submerged breakwater on grunion spawning activities, which is currently underway, at Imperial Beach. Also, the Corps, as part of an engineering study of the project's effectiveness and impact on littoral movements, will monitor a point at the mouth of the Tijuana River Estuary to determine whether or not the project adversely impacts water exchange through the mouth of the estuary.

APPORTIONMENT OF COSTS

The Federal share of the total project costs for the proposed project is equal to 50 percent of the first costs of constructing protective works of shores owned by non-Federal public agencies and 100 percent of the first costs of constructing protective works of shores owned by Federal agencies. The formula for determining the Federal share (ER 1120-2-110) is given as follows:

$$F = [(A/C) + (B/C) \times 0.5]\,100$$

Where: F = Federal share of total construction costs, percent.
A = beach frontage of shore owned by Federal agencies, feet.
B = beach frontage of shore owned by non-Federal public agencies, feet.
C = total beach frontage (A + B), feet.

For the proposed project, the approximate values are:

A = 700 feet. B = 4,300 feet. C = 5,000 feet.

Substituting the proposed project values into the Federal share formula, the Federal share is 57 percent. The Federal share is based on 57 percent of the total project cost not including the cost of the navigational aids. The Federal share includes 100 percent of the cost for the navigational aids. The Federal share is estimated to be $1,470,000. The non-Federal share is estimated at $1,090,000. The final cost-sharing shall be based on actual costs to be computed after completion of project construction.

DEPARTURES FROM THE PROJECT DOCUMENT PLAN

The authorized project was intended to protect the shoreline by the use of a system of five-groins. Partial implementation of this plan did not prove to be effective in restoring and maintaining the recreational beach. Model study results showed that the authorized plan would be ineffective in stabilizing the beach. The authorized project would have protected 6,300 feet of shoreline and the proposed plan would protect 5,000 feet of shoreline which amounts to a minus 20 percent change. The proposed plan provides essentially the same protection as the authorized project and has no significant changes; therefore, it is believed that the Chief of Engineers can utilize his discretionary authority to approve this plan.

PROPOSED LOCAL COOPERATION

The principal officers responsible for local cooperation are as follows:

Director, Dept. of Navigation and
Ocean Development, State of California - Resources Agency
1629 S Street
Sacramento, CA 95814

and

City Manager
City of Imperial Beach
825 Coronado Avenue
Imperial Beach, CA

Local interests are able and willing to meet the requirements of local cooperation, which are as follows:

a. Contribute in cash 43 percent of the local share of the total project first cost exclusive of the cost for the aids-to-navigation, presently estimated to be $1,090,000. Final cost-sharing shall be determined after completion of project construction.

b. Provide at their own expense all necessary lands, easements, and rights-of-way.

c. Control water pollution to the extent necessary to safeguard the health of bathers, except that which involves international cooperation, meeting all current Federal, State, and local water quality regulations.

d. Assure maintenance of the protective measures during the useful life of the project, as may be required to serve its intended purpose.

e. Assure continued public ownership of the beach and its administration for public use during the useful life of the project.

f. Hold and save the United States free from claims for damages that may result from construction and subsequent maintenance of the project, except those damages due to the fault or negligence of the United States or its contractors.

g. Provide and maintain necessary access roads, parking areas, and other public use facilities open and available to all on equal terms.

h. Comply fully with the requirements of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Public Law 91-646, 84 STAT. 1894) approved 2 January 1971.

The Mexican Government has controlled the previous pollution problem south of Imperial Beach. It is anticipated that there will be no pollution problem involving international cooperation.

STATEMENT OF FINDINGS

Available data concerning the various alternative actions for providing beach stabilization as well as views of interested agencies and concerned public have been reviewed and evaluated relative to the practicable alternatives in accomplishing the beach erosion control and minimizing the environmental impacts. The environmental, social, and economic effects of these alternatives have been studied, as well as the engineering feasibility of each plan. As part of the decision-making process, the merits of each alternative were considered. Each alternative was evaluated using the combined efforts of a multidisciplinary team of environmentalists, engineers, and economists. Based on the results of this evaluation, the submerged offshore breakwater alternative was found to best fulfill the social, environmental, economic, and other requirements.

Alternatives analyzed included the authorized five-groin plan, no action, condemnation and relocation, offshore vegetation, sand fencing, two groin systems, revetment, periodic beach nourishment, offshore surface-piercing breakwater, and submerged offshore breakwater.

Most of the alternatives either did not meet the planning objectives or were not engineeringly feasible. Studies have shown that the existing two groin system does not work. Two groin systems consisting of 7 or 9 groins appear to provide adequate beach stabilization but have higher costs than the selected plan. Periodic beach nourishment met the planning objectives but again was much more expensive than the selected plan. The offshore surface-piercing breakwater provided excellent beach stabilization but this plan was also more expensive and not as esthetically pleasing as the selected plan.

The environmental impact statement meets the requirements of the National Environmental Policy Act; the proposed action is based on a thorough analysis and evaluation of the various practicable alternatives for providing beach stabilization; the potential minor adverse environmental impacts of the project are outweighed by other considerations; and the recommended plan is consistent with national policy, statutes, and administrative directives. The total public interests would best be served by implementation of the recommended Imperial Beach project.

RECOMMENDATIONS

It is recommended that the plan described in this report as the selected plan and shown on plate 5 be approved as the basis for preparation of plans and specifications. It is also recommended that the Chief of Engineers exercise his discretionary authority to approve this report because it provides essentially the same protection as the authorized project and has no significant changes.

JAMES W. KEYS
Major, CE
Acting District Engineer

ATTACHMENT 1

DRAFT

AGREEMENT BETWEEN THE UNITED STATES OF AMERICA AND THE CITY OF IMPERIAL BEACH FOR THE LOCAL COOPERATION AT IMPERIAL BEACH

THIS AGREEMENT entered into this day of 19 by and between the UNITED STATES OF AMERICA (hereinafter called the "Government"), represented by the Contracting Officer executing this agreement, and the City of Imperial Beach, (hereinafter called the "City"),

WITHNESSETH THAT:

WHEREAS, construction of the Imperial Beach erosion control project (hereinafter called the "Project") was authorized by the River and Harbor Act of 1958 (Public Law 85-500); and

WHEREAS, the City hereby represents that it has the authority and capability to furnish the non-Federal cooperation required by the Federal legislation authorizing the Project and by other applicable law.

NOW, THEREFORE, the parties agree as follows:

1. The City agrees that, if the Government shall commence construction of the Imperial Beach Erosion Control Project in accordance with the plan set forth in the Los Angeles District Engineer's General Design Memorandum "Design Memorandum No. 4," dated (hereinafter called the GDM, the City shall in consideration of the Government commencing construction of such project, fulfill the requirements of non-Federal cooperation specified herein to wit:

a. Contribute in cash 43 percent of the total project first cost, exclusive of the cost for aids-to-navigation, presently estimated at $1,090,000. Final cost-sharing shall be determined after completion of project construction.

b. Provide at their own expense all necessary lands, easements, and rights-of-way.

c. Control water pollution to the extent necessary to safeguard the health of bathers, except that which involves international cooperation, meeting all current Federal, State, and local water quality regulations.

d. Assure maintenance of the protective measures during the useful life of the project, as may be required to serve its intended purposes.

e. Assure continued public ownership of the beach and its administration for public use during the useful life of the project.

f. Hold and save the Government free from claims for damages that may result from construction and subsequent maintenance of the project, except those damages due to the fault or negligence of the United States or its contractors.

g. Provide and maintain necessary access roads, parking areas, and other public use facilities open and available to all on equal terms.

h. Comply with the requirements of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Public Law 91-646, 84 Stat. 1894) approved 2 January 1971.

2. The City hereby gives the Government a right to enter upon, at reasonable times and in a reasonable manner, lands which the City owns or controls, for access to the project for the purpose of inspection, and for the purpose of operating, repairing, and maintaining the project, if such inspection shows that the City for any reason is failing to operate, repair and maintain the project in accordance with the assurances hereunder and has persisted in such failure after a reasonable notice in writing by the Government is delivered to the City. No operation, repair and maintenance by the Government in such event shall operate to relieve the City of responsibility to meet its obligations as set forth in paragraph 1 of this agreement, or to preclude the Government from pursuing any other remedy at law or equity.

3. This agreement is subject to the approval of the Secretary of the Army.

IN WITNESS WHEREOF, the parties hereto have executed this contract as of the day and year first above written.

THE UNITED STATES OF AMERICA

By
Colonel, Corps of Engineers
District Engineer
Contracting Officer

DATE:

APPROVED:

Secretary of the Army

THE CITY OF IMPERIAL BEACH

By
Title

CERTIFICATION

I, as Chief legal officer for the City of Imperial Beach, hereby certify that the foregoing agreement executed by City Council, is within the scope of his authority to act upon behalf of the City of Imperial Beach and that in my capacity as Chief legal officer for the City of Imperial Beach, I have considered the legal effects of Section 221 of the Flood Control Act of 1970 (42 USC 1962d-5b) and find that the City of Imperial Beach is legally and financially capable of entering into the contractual obligations contained in the foregoing agreement and that, upon acceptance, it will be legally enforceable.

Given under my hand, this day of 197 .

City Counsel,
City of Imperial Beach

THE CITY OF
IMPERIAL
BEACH 825 CORONADO AVENUE - P. O. BOX 427 - IMPERIAL BEACH, CALIFORNIA 423-8300

OFFICE OF
THE MAYOR

January 19, 1978

Dan Muslin
Project Manager
Department of the Army
Corps of Engineers
300 No. Los Angeles St.
P.O. Box 2711
Los Angeles, CA 90053

Dear Dan:

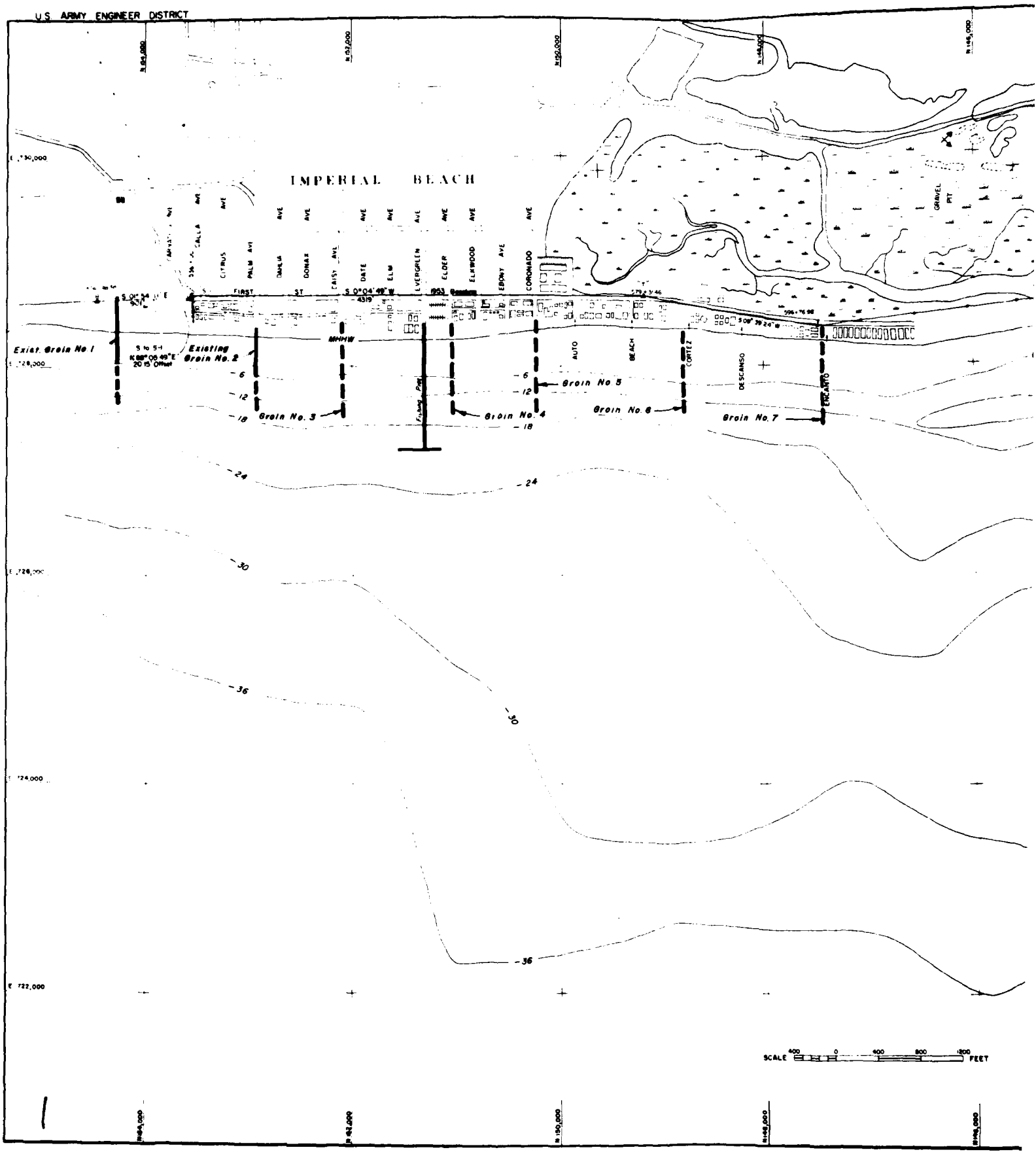
The City Council of the City of Imperial Beach by minute action taken at its meeting of January 17, 1978, has directed me to advise you that the City of Imperial Beach has reviewed the local interest requirements contained in the draft UNITED STATES-CITY agreement for the Imperial Beach Erosion Control Project. The Council has further directed me to reaffirm the City's intention to furnish the necessary local cooperation required by said draft agreement which, I understand, is to be amended in order that Section 1f will read as follows:

"f. Hold and save the Government free from claims for damages that may result from construction and subsequent maintenance of the project except for claims for damages which arise out of the negligent conduct or acts of Government, its officers, employees or agents."

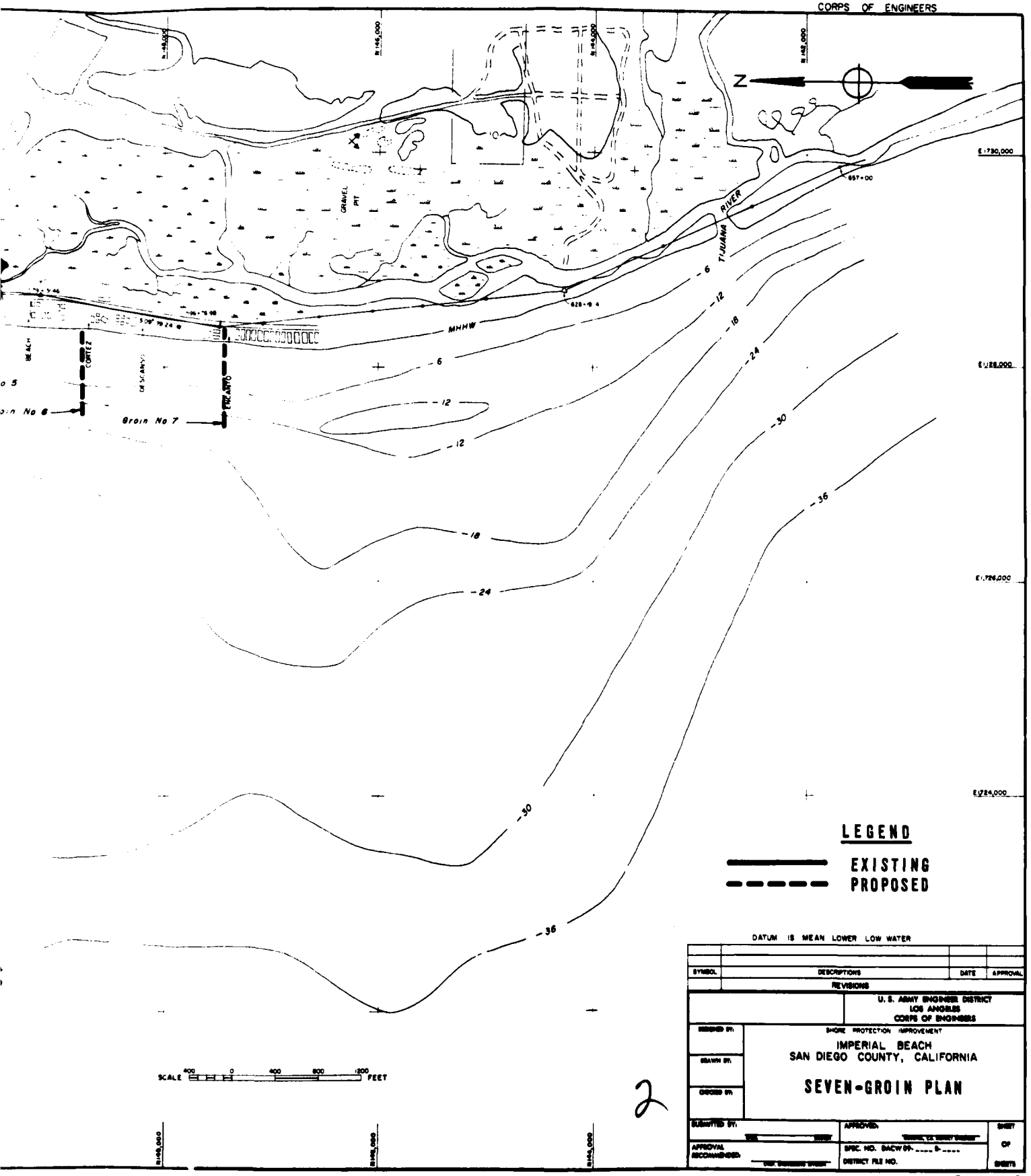
Sincerely yours,

ELVIN C. OGLE
Mayor

CER/ECO:bar


U.S. ARMY ENGINEER DISTRICT
IMPERIAL BEACH
FIRST ST
CITRUS AVE
PALM AVE
DAHLIA AVE
DONAX AVE
DATE AVE
ELM AVE
EVERGREEN AVE
ELDER AVE
ELMWOOD AVE
EBONY AVE
CORONADO AVE
AUTO
BEACH
CORTEZ
DESCANSO
ENCANTO
GRAVEL PIT
MHHW
Existing Groin No. 1
Existing Groin No. 2
Groin No. 3
Groin No. 4
Groin No. 5
Groin No. 6
Groin No. 7
SCALE 400 0 400 800 1200 FEET

CORPS OF ENGINEERS



LEGEND

EXISTING

PROPOSED

DATUM IS MEAN LOWER LOW WATER

SYMBOL	DESCRIPTIONS	DATE	APPROVAL
	REVISIONS		

U. S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY:
DRAWN BY:
CHECKED BY:

SHORE PROTECTION IMPROVEMENT

IMPERIAL BEACH
SAN DIEGO COUNTY, CALIFORNIA

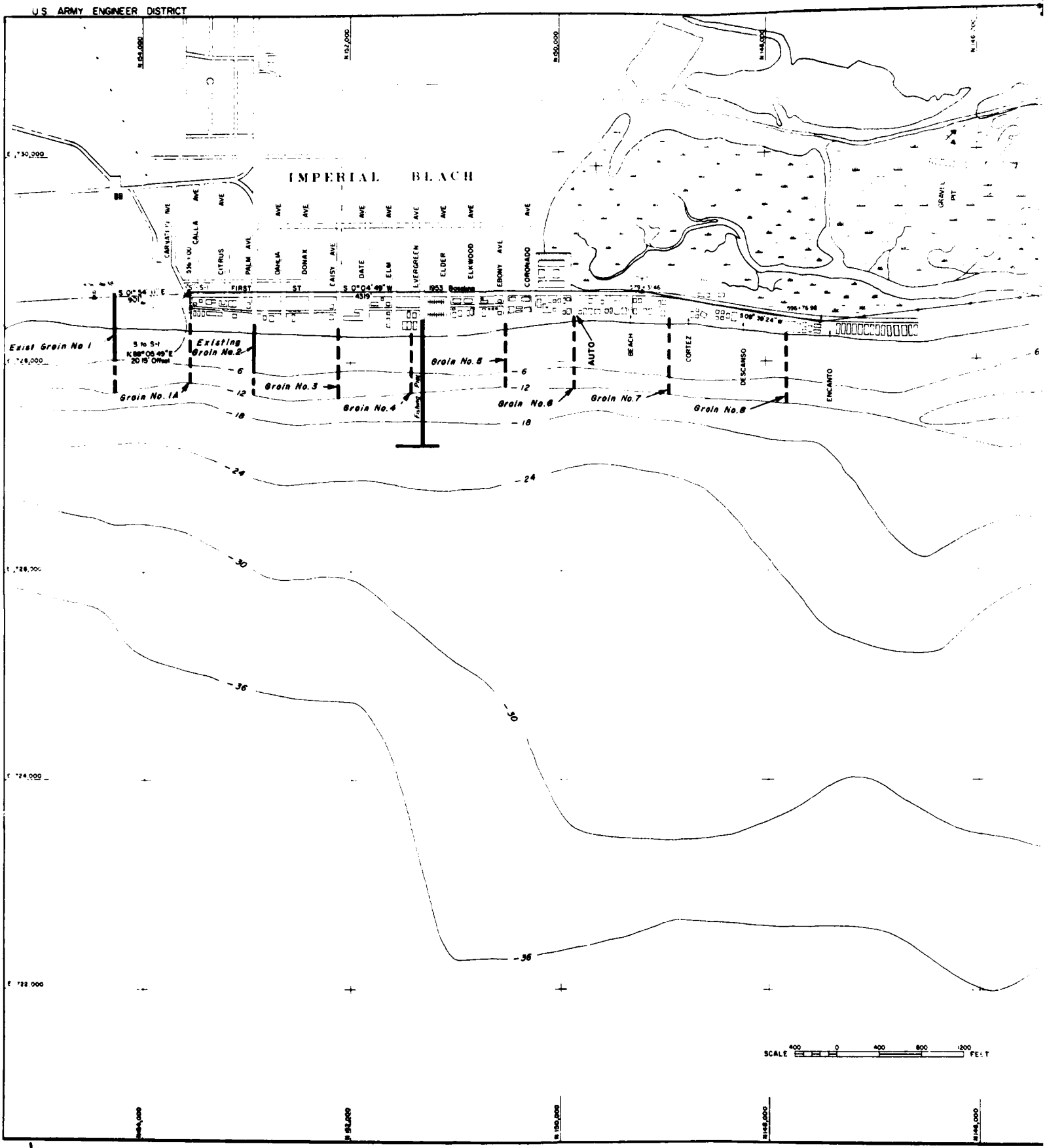
SEVEN-GROIN PLAN

SUBMITTED BY:
APPROVED:
APPROVAL RECOMMENDED:
SPEC. NO. DACW09-____-____
DISTRICT FILE NO.
SHEET
OF
SHEETS

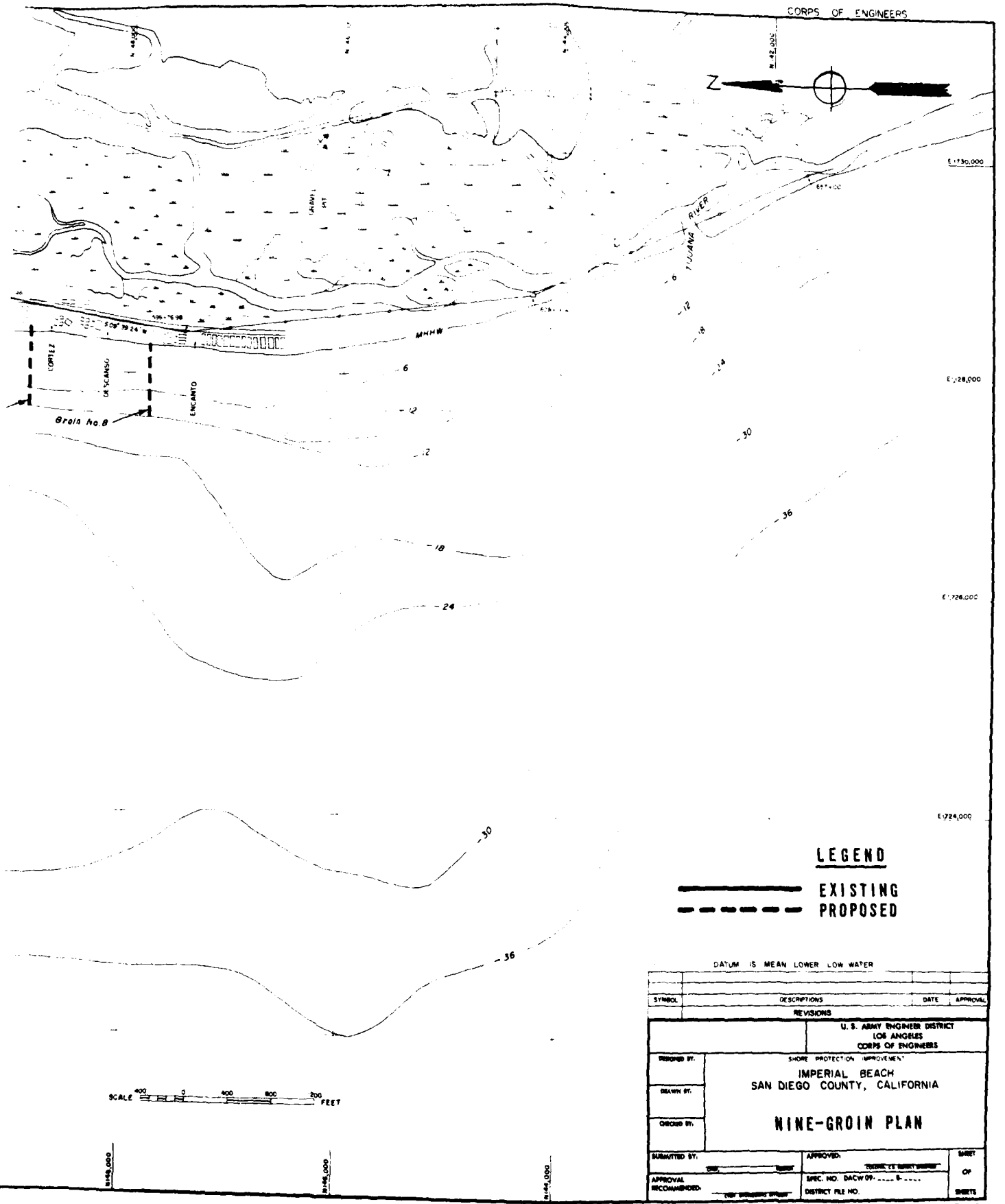
2

PLATE 1

U.S. ARMY ENGINEER DISTRICT



CORPS OF ENGINEERS



SYMBOL	DESCRIPTIONS	DATE	APPROVAL
	REVISIONS		

U. S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY:
DRAWN BY:
CHECKED BY:

SHORE PROTECTION IMPROVEMENT
IMPERIAL BEACH
SAN DIEGO COUNTY, CALIFORNIA

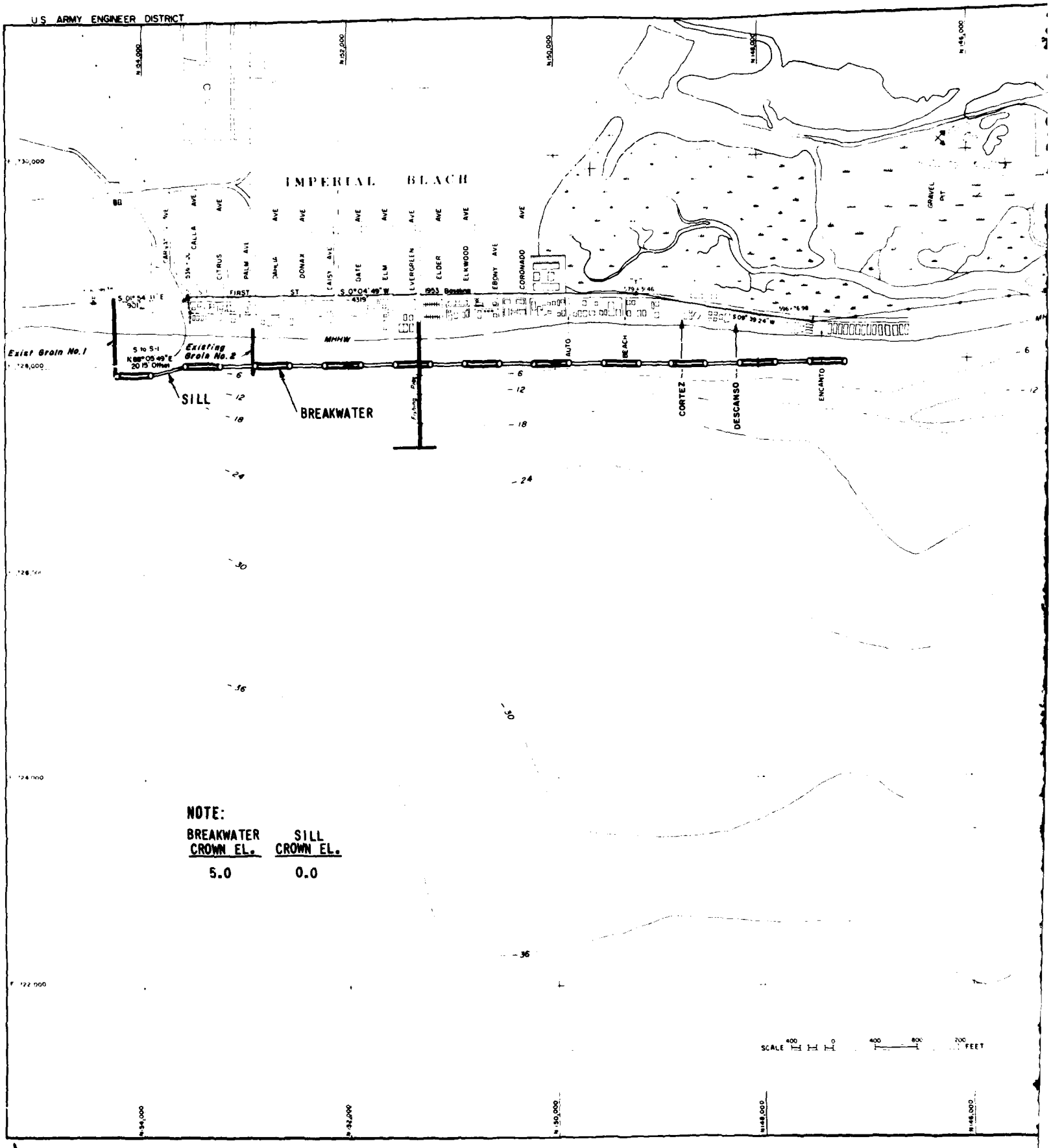
NINE-GROIN PLAN

SUBMITTED BY:
APPROVED:
APPROVAL RECOMMENDED:
SPEC. NO. DACW09- ---- B- ----
DISTRICT FILE NO.
SHEET OF SHEETS

2

PLATE 2

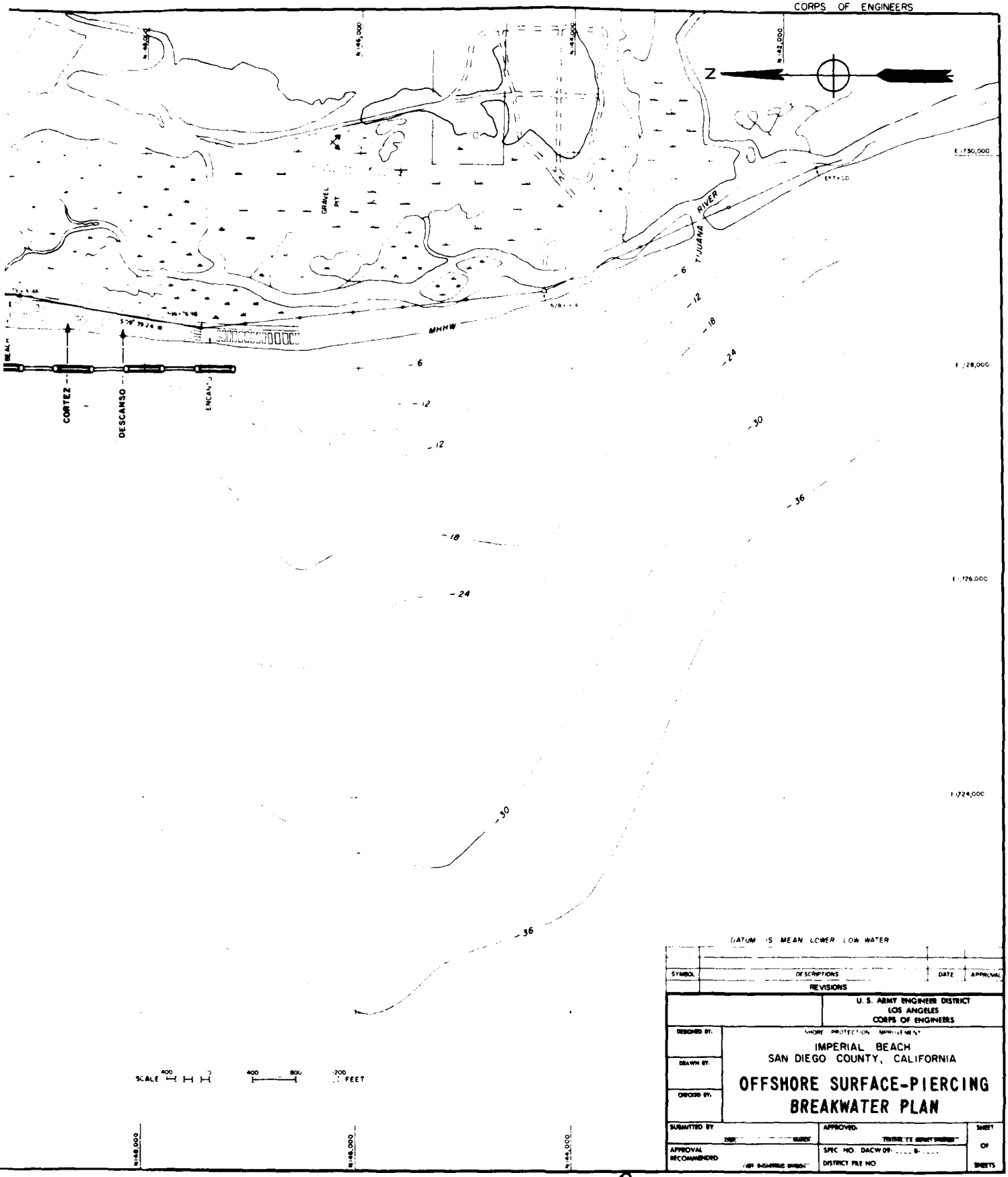
U.S. ARMY ENGINEER DISTRICT



NOTE:

BREAKWATER CROWN EL.	SILL CROWN EL.
5.0	0.0

CORPS OF ENGINEERS



SCALE 400 0 400 800 200 FEET

DATUM IS MEAN LOWER LOW WATER

SYMBOL	DESCRIPTIONS	DATE	APPROVAL
	REVISIONS		

U. S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY:
DRAWN BY:
CHECKED BY:

SHORE PROTECTION IMPROVEMENT

IMPERIAL BEACH
SAN DIEGO COUNTY, CALIFORNIA

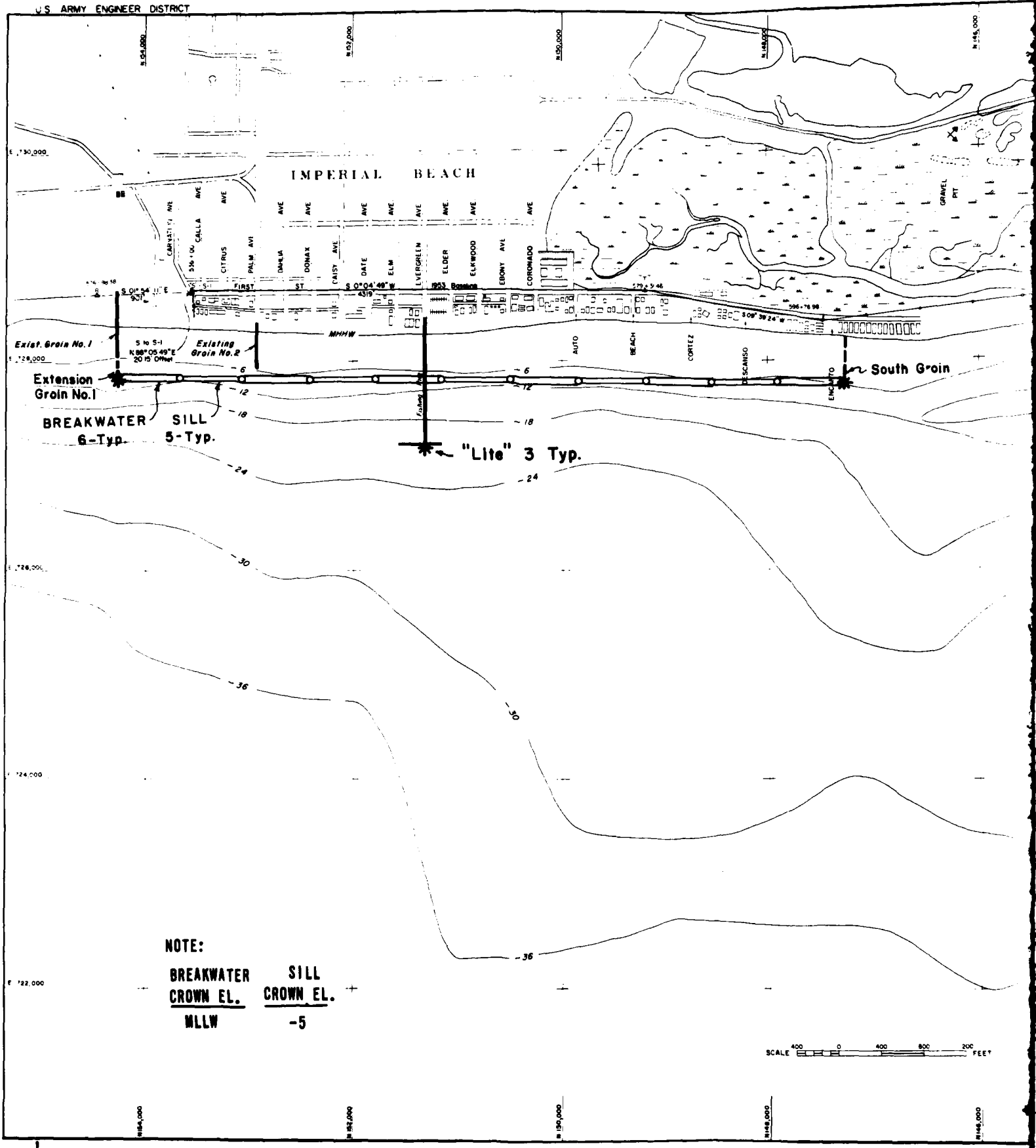
OFFSHORE SURFACE-PIERCING BREAKWATER PLAN

SUBMITTED BY: CHIEF, ENGINEERING DIVISION
APPROVED: DEPUTY DISTRICT ENGINEER
APPROVAL RECOMMENDED: CHIEF, PLANNING DIVISION
SPEC NO. DACW09-__-__-__
DISTRICT FILE NO.
SHEET OF SHEETS

2

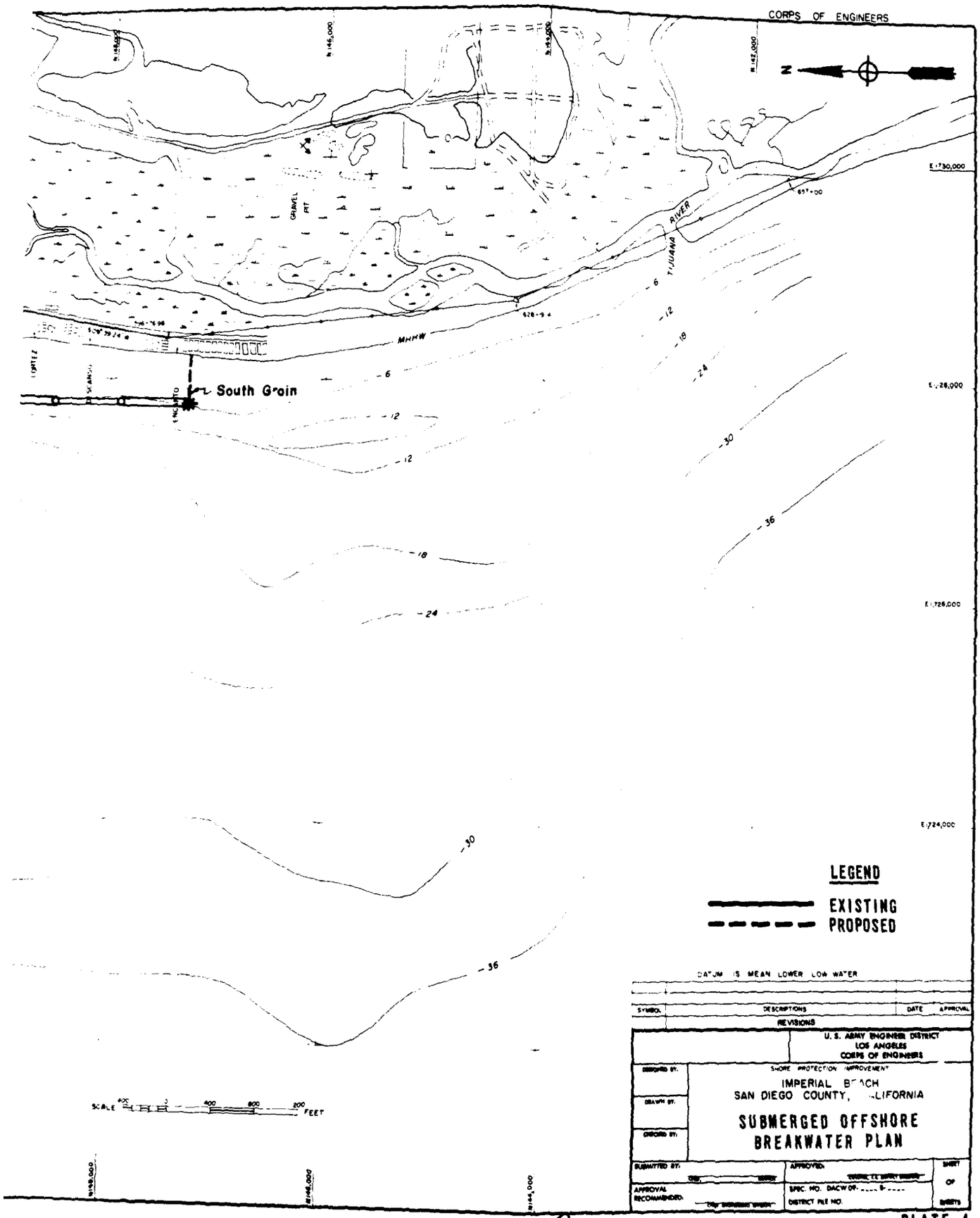
PLATE 3

U.S. ARMY ENGINEER DISTRICT



NOTE:

BREAKWATER CROWN EL.	SILL CROWN EL.
MLLW	-5



SYMBOL	DESCRIPTIONS	DATE	APPROVAL
	REVISIONS		

U. S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY:
DRAWN BY:
CHECKED BY:

SHORE PROTECTION IMPROVEMENT
IMPERIAL BEACH
SAN DIEGO COUNTY, CALIFORNIA

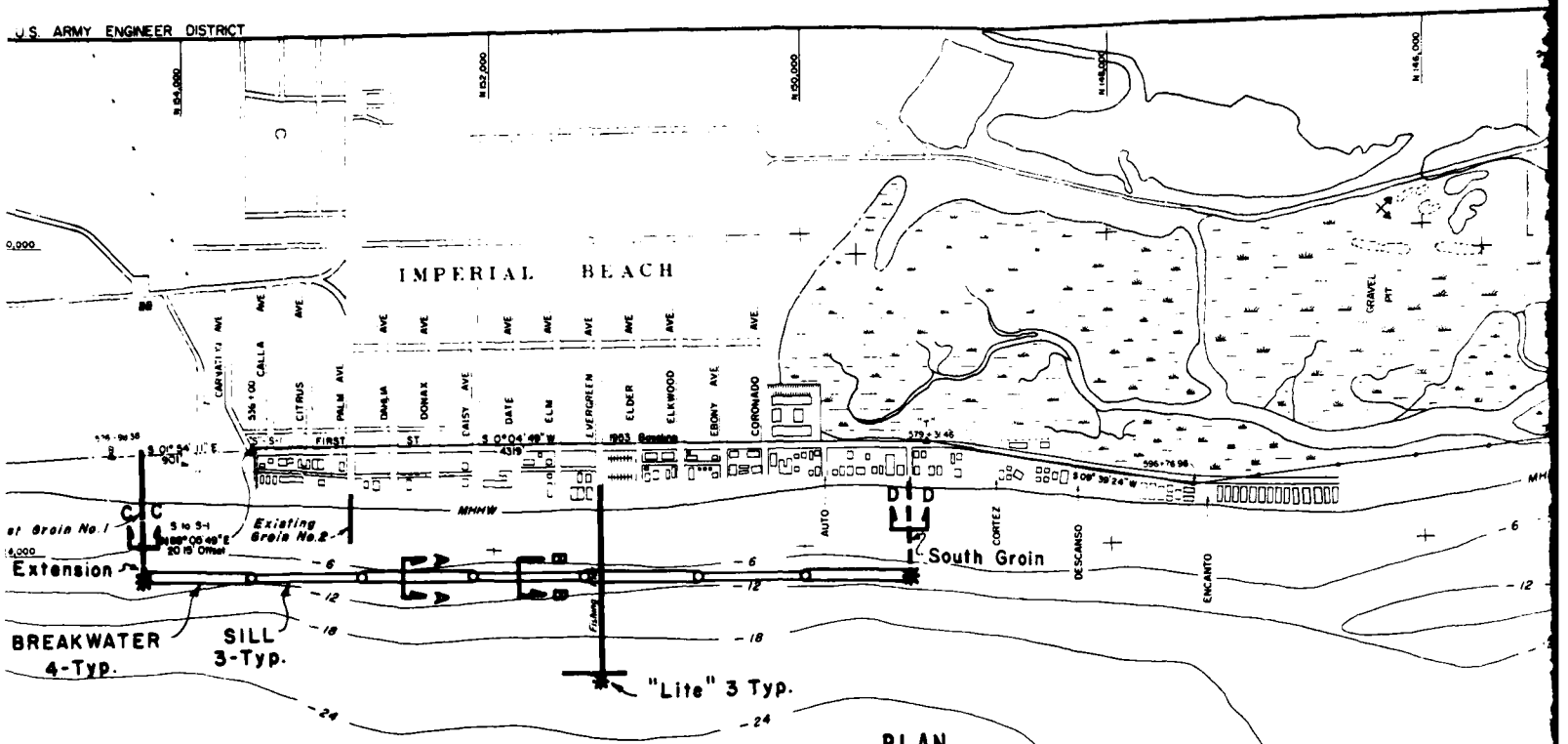
SUBMERGED OFFSHORE BREAKWATER PLAN

SUBMITTED BY: Chief, Engineering Division
APPROVED: Chief, Engineering Division
APPROVAL RECOMMENDED: Chief, Engineering Division
SPEC. NO. DACW09-____-B-____
DISTRICT FILE NO.
SHEET OF SHEETS

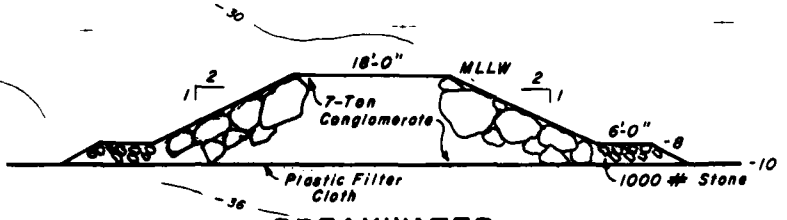
2

PLATE 4

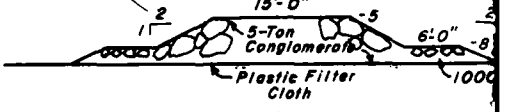
U.S. ARMY ENGINEER DISTRICT



PLAN

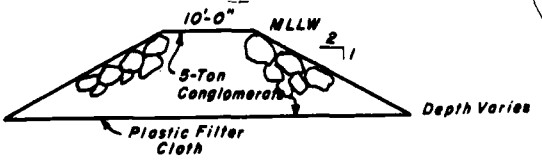


BREAKWATER
SECT. A-A



SILL
SECT. B-B

SCALE 1"20 Ft.
HORZ.
VERT.



GROIN No. 1
SECT. C-C

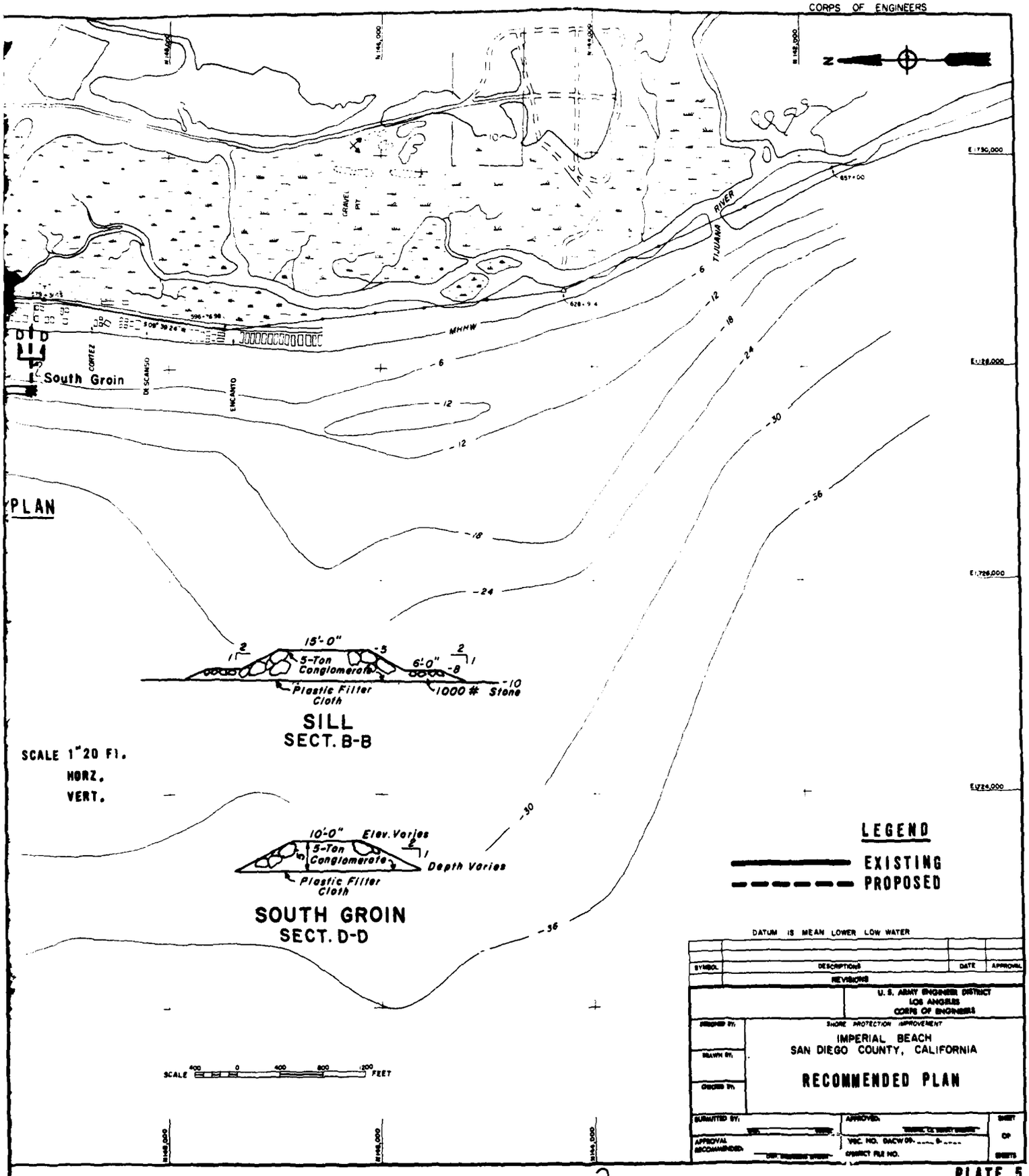
SOUTH GROIN
SECT. D-D

NOTE:

BREAKWATER CROWN EL.	SILL CROWN EL.
MLLW	-5

SCALE 400 0 400 800 1200 FEET

CORPS OF ENGINEERS



PLAN

SILL
SECT. B-B

SCALE 1"20 Ft.
HORZ.
VERT.

SOUTH GROIN
SECT. D-D

LEGEND

EXISTING

PROPOSED

SCALE 400 0 400 800 1200 FEET

DATUM IS MEAN LOWER LOW WATER

SYMBOL	DESCRIPTIONS	DATE	APPROVAL
	REVISIONS		

U. S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY:
DRAWN BY:
CHECKED BY:

SHORE PROTECTION IMPROVEMENT
IMPERIAL BEACH
SAN DIEGO COUNTY, CALIFORNIA

RECOMMENDED PLAN

SUBMITTED BY:
APPROVED:
APPROVAL RECOMMENDED:
SHEET OF SHEETS
WDC. NO. SACW 09-
DISTRICT FILE NO.

PLATE 5

2


DATE
FILMED
0-8